KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, FEB. 6, 1885.

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ON SOME CAUSES OF EARTHQUAKES.

By Richard A. Proctor.

IT has been noticed that the Spanish earthquakes have been followed by hurricanes, and many are asking how earthquakes can cause hurricanes. "When an earthquake is succeeded by a hurricane," says the *New York Tribune*, "the inference must be that if the occurrence of the wind storm is more than a coincidence, it must be caused by a profound atmospheric change of pressure, such a change as could only be produced probably by an electrical storm of exceeding violence." This I only quote to show how the question has been raised on the American side of the Atlantic. Of electricity, one may say what Laplace said about the theory of special interference of the Almighty as an explanation of unusual phenomena—"*Ça explique beaucoup de choses.*" It does not seem to have been noticed that the Spanish earthquakes followed a remarkable series of Atlantic storms, and that these earthquakes have continued since the great hurricanes occurred which drove the *Tribune* to the all-explaining electrical theory.

If we consider the matter with a little attention, we shall cease to wonder that great atmospheric disturbances excite subterranean activity. The effects of what seem slight changes of atmospheric pressure must in reality be enormous in modifying the pressures underneath the earth's crust. The barometer often ranges half-in-inch in height without any great hurricanes following. Taking such a change as this, and supposing that over an area as large as the British Isles, and with the seas between them—say, in round numbers, 100,000 square miles—the barometer stands at 29¼ in., while on either side, over a similar area, the barometric column has an average height of 29¾ in.; let us consider what difference of pressure is involved, and what are the changes produced if the barometric column is raised half-an-inch over the British area, and lowered by half-an-inch over the adjacent areas. The pressure of the air on a square inch, when the barometer stands at 30 in., is nearly 15 lb., so that a fall of half-an-inch (one-sixtieth of thirty) means a reduction of pressure by nearly a quarter-of-a-pound to the square inch. (Or, of course, we may leave the air out of the question, and simply weigh a half-inch of mercury in height on a square inch base; this will be one 3,456th part of a cubic foot of mercury, and every one knows that a cubic foot of mercury weighs 848 lb.; the 3,456th part of 848 × 16 oz. is 3$\frac{5}{27}$ oz.) Now, in a square yard there are 1,296 square inches, and in a square mile about 3,000,000 square yards. Therefore, at a quarter of a lb. to the square inch, the pressure on a square mile amounts to 324 times 3,000,000 lb., and the pressure on 100,000 square miles to no less than 97,200,000,000,000 lb. This is 1-54th part too great, because the pressure on a square inch is only 53 54ths of 4 oz. Knock off then a 54th part, getting for the actual difference of pressure due to a half-inch rise or fall of the mercurial barometer 95,450,000,000,000 lb., or in round numbers 42,600,000,000 tons. Can it be supposed to be a slight matter if, as frequently happens, such an enormous pressure as this is thrown upon the area of the British Isles and the seas around and between them, in the course of a few hours, while adjacent areas are relieved of a corresponding weight, and then a few hours later the adjacent areas are oppressed by having many thousands of millions of tons extra weight thrown upon them, while the pressure on the British Isles is diminished in the same tremendous degree? We hear it sometimes described as a remarkable thing that great barometric changes are followed by signs of disturbances in British mines; but when we see that only a moderate and normal change of atmospheric pressure means many thousands of millions of tons added to the pressure on the earth's crust in and around Great Britain, or deducted from that pressure, the wonder seems rather to be that changes so slight are produced by pressures so enormous.

Now the disturbed areas in the hurricanes of last December were very much larger than those I have just considered, and the differences of atmospheric pressure much more remarkable. The areas of diminished pressure were probably not less than 500,000 square miles, and the surrounding areas of increased pressure fully as large, while the range of the barometer was in some cases fully 2 inches. This would make the weights added to and taken away from the disturbed areas, sometimes very quickly, no less than a thousand billions of tons. Can we wonder if parts of the earth where the crust is relatively weak and unstable should show the effects of such tremendous changes of pressure as these?

But this is not all. The seas respond to the action of mighty hurricanes, not only by being tossed into waves (which in the open sea are mere risings and fallings of masses of water not themselves carried along), but by being carried in large masses before the winds. Every one knows how a moderate tide is changed into a very high tide by favouring winds, while an expected very high tide becomes a moderate tide when the wind opposes the influx of the water. Along a shore-line such as that presented by the Spanish Peninsula towards the west the water must often be raised two or three feet above its normal level by the action of long-continued strong winds from the west. Now, consider one hundred miles of shore-line, and the effects of a rise of the sea by only one foot on account of westerly hurricanes, that rise extending only ten miles out to sea. We have then a thousand square miles of water, one foot deep, as the extra pressure upon the crust under that shore-line. This gives 27,000 millions of cubic feet of water, each cubic foot weighing 1,000 oz., or in round numbers about 750 millions of tons of extra water thrown on a shore-line only a hundred miles in length. Along

800 miles the additional pressure would be 6,000 millions of tons. This, it will be observed, is very much smaller than the effect due to changes of atmospheric pressure over such an area as the British Isles, but the extra pressure per square mile is nearly twice as great on account of a foot rise in water as on account of a half-inch rise of the mercurial barometer. (In the above computation I have taken a cubic foot of water as 1,000 oz. As a matter of fact, a cubic foot of sea water weighs considerably more, averaging 64½ lb. instead of 62½ lb.—the weight of a cubic foot of fresh water.)

But the rise in the water level due to hurricanes is merely an addition to the rise due to the tides. An extra foot or two due to long-continued shoreward winds, added to several feet due to high spring tides, would signify tens of thousands of millions of tons of increased pressure on the Spanish and Portuguese shore-line. Moreover, an addition of this enormous weight on one side of a certain definite coast-line, while on the other side of this shore-line no change at all occurs from this cause, cannot but be a most potent disturbing cause—in a region, too, where the very existence of a shore-line indicates irregularity in the structure of the earth's crust beneath.

I take it, then, that we may fairly consider that the external action exerted upon the earth's crust, as the tidal wave sweeps upon a shore-line, as winds heap up the seas there, and as atmospheric pressure increases and diminishes—especially during the progress of great storms—must play a most important part in producing subterranean disturbances. At every moment of time millions of millions of tons of matter, in the form of water and air, are being flung hither and thither over the surface of the earth. Can we wonder if, apart from interior causes of disturbance, the crust shows signs of occasional fluctuation?—*Newcastle Weekly Chronicle.*

THE PHILOSOPHY OF CLOTHING.

By W. Mattieu Williams.

I.—OUR NATURAL CLOTHING.

WE know very little about the beginnings of man—nothing, at present, of the aboriginal human being; one of the widest gaps in the geological record being that between the lowest specimen of the two-handed creature and the highest of the four-handed. Every new paleontological discovery fills up or narrows one of the lower gaps, but from the beginnings of geology to the present time absolutely nothing has been found that bridges over this upper chasm—no fossil of human type that is less human than some living savages; no monkey, no anthropoid ape that is more anthropoid—more nearly human—than the living gorilla, orang-outang, or chimpanzee.

Are we, therefore, to conclude that the creation of man was exceptional—that there was actually an original break in that continuity of progressive development which is otherwise revealed to us in the great Book of Genesis which geology has opened; or is it that this chapter is yet unread?

What has this question to do with clothing? some of my readers will exclaim. My reply is, that clothing suggests the answer to it. The fact that we cannot live in the "temperate" zones of the earth without clothing shows that we are foreigners here—that we have wandered from the birth-place of our race, and therefore cannot expect to find any remains of our aboriginal ancestors in British railway cuttings or other European excavations.

Our own bare backs and tender skin, the geographical distribution of the nearest of our poor relations, the shadowy rumours of tradition, and the most ancient monumental remains, all indicate a tropical or sub-tropical origin of man—rather tropical than sub-tropical; and seeing that these tropical regions, where the fossil bones of our primitive ancestors probably lie, are practically unexplored, the most interesting chapter of the geological revelation is demonstrably still unopened.

It may be different presently. When cuttings are made for a Grand Junction Railway between the Congo and the Nile, when the British Association holds a colonial meeting at Khartoum, as it did last year at Montreal, specimens of many missing links will probably be shown at the geological section to illustrate papers on arboreal men and troglodite apes.

In order to understand the true philosophy of clothing it is necessary always to bear in mind that our artificial clothing is merely a geographical accident, a damaging impediment, a necessary evil that we have to mitigate as much as possible, by so selecting its material and adapting its form that we may protect ourselves from the chilling mischief of our surroundings, with as little sacrifice as possible of the free, cutaneous transpiration that we should enjoy in our aboriginally native climate.

We are told that the ancient Britons were naked savages who painted their bodies, probably with earthy or ochreous pigments. It is usually supposed that they did this simply for ornament sake. I suspect, however, that the practice originated with the simple and inevitable discovery that a layer of mud or clay, or dirt of any kind, checked the cooling effect of free evaporation from the skin, and thus the painting of the body served very rudely one of the purposes of clothing; that it was the most primitive and (with the exception of tight stays) the worst kind of human clothing.

So far as Julius Cæsar's description is concerned, we must remember that Roman armies rarely, if ever, marched during the winter; that he made his first acquaintance with our shores in the summer-time, when such supplementary covering as the skins of beasts was not fashionable. It is doubtful whether, even with the aid of much paint, any human beings could endure even the mild winters of our island, still less those of Continental Europe.

We know by their remains that primitive, pre-historic men took refuge in limestone caverns. They would there find a mild winter climate, and I am inclined to regard this as the chief influence which drove them into the retreats, rather than to suppose that they chose these caverns as a refuge from wild beasts. The intermingling of flint weapons with the bones of bears, hyenas, wolves, &c., rather indicate a struggle on both side for the possession of these "eligible family mansions" during frosty weather.

The first questions to be answered in considering the subject of clothing philosophically is, Why do we require clothing under any circumstances, and how does clothing act in supplying the requirement?

The answer to the first part of this question is simple enough. We, in common with all the other warm-blooded animals, have a bodily temperature considerably above that of the mean temperature of the temperate zones of the earth—above even of that of the tropics. The maintenance of this temperature is absolutely necessary for the maintenance of our health, and even of our life.

Whenever a body of any kind, animate or inanimate, has a temperature above that of its surroundings, it radiates away to those surroundings more heat than it

receives from them, and thus is continually cooling down in proportion to the amount of the difference and the degree of free exposure. We accordingly find that all the warm-blooded animals are supplied with special organic arrangements for checking this radiation.

Those most nearly allied to ourselves are covered with hair or wool; birds are well clad with feathers; and the warm-blooded animals that live wholly or partially in the sea—the whales, dolphins, porpoises, &c., and the seals—are enveloped in a tight-fitting overcoat of blubber, an enveloping layer of fat impermeable by the water, and a very effective resister of the passage of heat.

Even ourselves are not absolutely naked, for besides an insignificant supply of hair we are enveloped in a thin overcoat of cuticle, which encloses more or less of fat that acts like the blubber of the seals and whales in checking the radiation of our animal heat.

I may add that this beneficent endowment of fat varies to some extent with the climate, but by no means sufficiently to put us on a level with the fur-clad animals.

Our enveloping cuticle, like the hair and nails that are connected with it as structural modifications of developments of itself, is passive and insensible, may fairly be regarded as a mere protecting envelope to the dermis or "true skin" below it, which true skin is the seat of the vital skin functions. I shall, therefore, regard this cuticle as our natural clothing, or that which we merely supplement by artificial clothing, and describe it first as the model clothing of nature which art should strive to imitate.

According to this view of the subject, the artificial clothing with which we cover the cuticle should bear as nearly as possible the same relation to the cuticle that the cuticle bears to the cutis. It should protect the cuticle as the cuticle protects the cutis; it should, at the same time, permit the transpiration, respiration, and other functions carried on through the cuticle to be carried further and similarly through the artificial garments by devices as nearly similar as the nature of the problem and the feebleness of our arts permit.

An examination of the structure of the cuticle is, therefore, a first step in this exposition of the Philosophy of Clothing.

OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p.* 63.)

THE most important of all the questions depending on dual consciousness is one into which I could not properly enter at any length in these pages—the question, namely, of the relation between the condition of the brain and responsibility, whether such responsibility be considered with reference to human laws or to a higher and all-knowing tribunal. But there are some points not wanting in interest which may be here more properly considered.

In the first place it is to be noticed that a person who has passed into a state of abnormal consciousness, or who is in the habit of doing so, can have no knowledge of the fact in his normal condition except from the information of others. The boy at Norwood might be told of what he had said and done while in his less usual condition, but so far as any experience of his own was concerned, he might during all that time have been in a profound sleep. Similarly of all the other cases. So that we have here the singular circumstance to consider, that a person may have to depend on the information of others respecting his own behaviour—not during sleep or mental aberration or ordinary absence of mind—but (in some cases at least) while in possession of all his faculties and unquestionably responsible for his actions. Not only might a person find himself thus held responsible for actions of which he had no knowledge, and perhaps undeservedly blamed or condemned, but he might find himself regarded as untruthful because of his perfectly honest denial of all knowledge of the conduct attributed to him. If such cases were common, again, it would not improbably happen that the simulation of dual consciousness would become a frequent means of attempting to evade responsibility.

Another curious point to be noticed is this. Supposing one subject to alternations of consciousness were told that in his abnormal condition he suffered intense pain or mental anguish in consequence of particular actions during his normal state, how far would he be influenced to refrain from such actions by the fear of causing pain or sorrow to his "double," a being of whose pains and sorrows, nay, of whose very existence, he was unconscious? In ordinary life a man refrains from particular actions which have been followed by unpleasant consequences, reasoning, in some cases, "I will not do so-and-so, because I suffered on such and such occasions when I did so" (we set religious considerations entirely on one side by assuming that the particular actions are not contrary to any moral law), in others, "I will not do so-and-so because my so doing on former occasions has caused trouble to my friend A or B;" but it is strange to imagine any one reasoning, "I will not do so-and-so because my so doing on former occasions has caused my second self to experience pain and anguish, of which I myself have not the slightest recollection." A man may care for his own well-being, or be unwilling to bring trouble on his friends, but who is that second self that his troubles shall excite the sympathy of his fellow-consciousness? The considerations here touched on are not so entirely beyond ordinary experience as might be supposed. It may happen to any man to have occasion to enter into an apparently unconscious condition during which in reality severe pains may be suffered by another self, though on his return to his ordinary condition no recollection of those pains may remain, and though to all appearance he has been all the time in a state of absolute stupor; and it may be a reasonable question, not perhaps whether he or his double shall suffer such pains, but whether the body which both inhabit will suffer while he is unconscious, or while that other consciousness comes into existence. That this is no imaginary supposition is shown by several cases in Abercrombie's treatise on the "Intellectual Powers." Take, for instance, the following narrative:—"A boy," he tells us, "at the age of four suffered fracture of the skull, for which he underwent the operation of the trepan. He was at the time in a state of perfect stupor, and after his recovery retained no recollection either of the accident or of the operation. At the age of fifteen, however, during the delirium of fever, he gave his mother an account of the operation, and the persons who were present at it, with a correct description of their dress, and other minute particulars. He had never been observed to allude to it before; and no means were known by which he could have acquired the circumstances which he mentioned." Suppose one day a person in the delirium of fever or under some other exciting cause should describe the tortures experienced during some operation, when, under the influence of anæsthetics, he had appeared to all around to be totally unconscious, dwelling in a special manner perhaps on the horror of pains accompanied by utter powerlessness to shriek or groan, or even to move; how far would the possibilities suggested by such a narrative influence one who had a painful operation to undergo, knowing, as he

XUM

would quite certainly, that whatever pains his *alter ego* might have to suffer, not the slightest recollection of them would remain in his ordinary condition?

There is indeed almost as strange a mystery in unconsciousness as there is in the phenomena of dual consciousness. The man who has passed for a time into unconsciousness through a blow, or fall, or fit, cannot help asking himself, like Bernard Langton, in that weird tale, "Elsie Venner," "Where was the mind, the soul, the thinking principle all that time?" It is irresistibly borne in upon him that he has been dead for a time. As Holmes reasons, "a man is stunned by a blow and becomes unconscious, another gets a harder blow and it kills him. Does he become unconscious, too? If so, *when*, and *how does he come to his consciousness?* The man who has had a slight and moderate blow comes to himself when the immediate shock passes off and the organs begin to work again, or when a bit of the skull is 'pried' up, if that happens to be broken. Suppose the blow is hard enough to spoil the brain and stop the play of the organs, what happens then?" So far as physical science is concerned, there is no answer to this question; but physical science does not as yet comprehend all the knowable, and the knowable comprehends not all that has been, is, and will be. What we know and can know is nothing, the unknown and the unknowable are alike infinite.

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from page* 64.)

THE many demands made upon our space a fortnight since compelled me to curtail my article, and so to leave unsaid a few remarks on solder and soldering, which I will now proceed to make.

Ex. XII. The process of tinning the soldering-iron may be facilitated by employing a tinning-tray, consisting of a spoon or tray-shaped piece of sheet-brass, iron, or other convenient metal. The tray may be made by cutting from each of the corners of a piece of metal (about 2 in. square) little pieces, say, a quarter of an inch square, and then bending up a quarter of an inch of the sides; this will make a tray 1½ in. square. In this is a small quantity of solder and a little spirits of salts. The hot iron, if properly cleaned — by filing with a bastard (coarse) file — will become tinned immediately on heating it into the solder. The success of soldering depends to a great extent upon a due observance of the following precautions, (*a*) keep the iron in a clean tinned state; (*b*) never allow the iron to become redhot, or the tin will be burnt off (necessitating a repetition of the filing and tinning process), but heat it just sufficient to melt the solder, and wipe the end with a *clean* rag; this leaves the iron with a good tinned surface; (*c*) thoroughly cleanse the surfaces of joints to be soldered, (*d*) apply carefully the spirits or resin, whichever is used.

Ex. XIII. It was said (Ex. XI.) that strip solder should be used. Ordinarily, when strip solder is specified, a soft solder is meant. Some comparatively hard solders are made in the strip form—that is to say, the solder is run into strips a foot or so long, a quarter of an inch wide, and about a sixteenth thick. Ordinary soft solder, although easy to work, is too soft and too easily broken, if used where any strain is exerted. Consequently, in forming a metallic junction between pieces of copper or brass, "blowpipe" solder answers best because of its comparative hardness. Having learned to work soft solder, the young worker should next try his hand with the more difficult blowpipe solder. It may be obtained at the rate of one shilling a pound, or a single strip may be purchased for a penny.

Ex. XIV. The soldering-iron is a most important tool, and no worker should be without one. I give here the details for making one, at the cost of a few pence. A piece of bar copper, A B, Fig. 1, about 3½ in. long and ⅝ in.

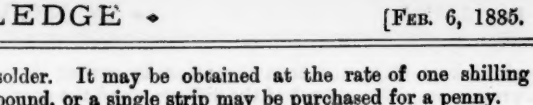


Fig. 1.

square, is brought to a square point at the end A, the facets making an angle of about 60° with each other. The end B has a saw- or file-cut, ⅛ in. wide and ½ in. deep. A piece of round iron rod (B C), 5-16 in. in diameter and about 4 in. long, is flattened out by making the end B red-hot, and then spreading it with a hammer, upon an anvil or iron block, to a wedge shape. The end C is reduced to a slightly tapering square. The iron, having been flattened to the necessary extent, is then fixed into the saw-cut in A B. A small hole is then drilled * through the copper-prongs made by the saw- or file-cut, and the iron tongue, and a rivet of any convenient metal passed through and hammered down, as illustrated in the figure. The copper and the iron will then be rigidly attached one to the other. A wooden handle having been procured (a chisel or file handle will do, or a new one may be obtained for a penny or so), the end C of the iron is made red hot and is then burnt for half an inch or so into the handle, and then removed and allowed to cool. When cool, place the iron stem in a vice,† or any other convenient place, and drive the handle on to the iron for an extra quarter of an inch. This must be done carefully, or the handle may be split. When finished, a a soldering-iron will have been made at the most trifling cost, and yet it will prove quite as efficient as any that may be purchased, and will be found quite large enough for any purpose for which we may require it in the course of these papers.

Ex. XV. For the purpose of cutting wire, &c., pliers will be found essential. The worker had better, therefore, be provided with a pair of 4-inch cutting-pliers and a pair of 4-inch nipping-pliers.

Ex. XVI. For cutting metal-foil or very thin sheets, a good pair of scissors will suffice.

Ex. XVII. Stouter sheets, if not *too* thick, yield to a pair of shears with 3-in. blades and a 7-in. handle. In using them the metal to be cut should always be placed as near as possible to the rivet which holds the blades together. The metal may then be cut for an inch or so, and then

Fig. 2.

advanced again towards the shears. A little practice will make evident the necessity for not allowing the blades to cut through their whole length, otherwise a series of ridges or notches will be left. One other precaution must be observed, and that is to keep the cutting edges in as nearly the same plane as possible, that is to say, press the handles apart and so press the blades together.

Ex. XVIII. Even shears will not do when we wish to cut

* Drills and drilling will be dealt with in the next succeeding article.

† See next article.

rods or thick sheets of metal. For copper, brass, or iron a saw is necessary, *but steel should never be touched with a saw.* There are three forms of saws to be used in working metals.

Ex. XIX. The first is the back-saw (Fig. 2), in which the blade A B, about 5 in. long and 1 in. wide, is fixed in the back, C D. The back is fastened into the handle, E, the axis of which is in a line with the back.

Ex. XX. The frame-saw is shown in Fig. 3. To the handle, E, is attached the frame, A B C. The saw (12 in.

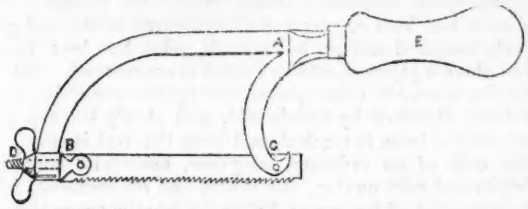


Fig. 3.

long) is attached to the frame at B and C, and is tightened by the nut, D.

Ex. XXI. The fret-saw is used when cutting sharp curves. A similar (but lighter) frame to that employed in Ex. XX. is used, the narrow blades, which are made interchangeable, being suitable for cutting curves in material which is not of a heavy nature. The size of the saw depends upon the kind of work to be performed.

Ex. XXII. In essaying to saw a piece of copper or brass (sheet or rod), place the metal in a vice, and cut the faces with a frame- or back-saw. It is necessary that the young worker should practise himself on this work, paying particular attention to the way in which he holds and works his saw. He must keep it as nearly horizontal as possible throughout the stroke, and should make a horizontal cut in the metal. He must avoid making a cut which is, say, half an inch deep at the extremities and only a quarter of an inch in the middle. When the faces are all cut, the piece of metal may, if the cuts are deep enough, be broken into two parts, by fixing one end in a vice, and breaking the parts asunder. If unable to break the metal, it should be sawn a little deeper, and again tried until it does become breakable.

Ex. XXIII. To cut iron, the same general plan may be adopted, using the frame-saw, with—in the case of *wrought* iron—a liberal supply of oil or water, but omitting this when cutting *cast* iron.

Ex. XXIV. To cut steel, which, as already stated, must not be attempted with the saw, cut all the sides with the edge

Fig. 4. Fig. 5. Fig. 6.

of either a half-round (Fig. 4), three-square (Fig. 5), or crossing (Fig. 6) rough file. Then snap off the part to be removed in a strong vice. Should it happen that there is no vice available of sufficient strength, place the line of severance over a hole, not less than an inch in diameter, in an iron plate, and strike it with the edge of a hammer, or the piece of steel may be laid over two straight pieces of iron and then broken between them by a smart blow from a hammer. There is some little danger attending this operation, as one portion of the steel being held, the other will fly if the fracture is obtained. If, however, a second party is not present, and the worker keeps his face clear, he need have no fear of any harm being done. Sometimes the process fails, in which case the cut is insufficiently deep. It should be deepened and the hammering repeated until success is attained.

ON TERMITES.

By Surgeon-General R. F. Hutchinson, M.D.

THE vulgar idea at home is that India is a prey to pests of all sorts; that you cannot go abroad without encountering a tiger or treading upon a serpent; that you cannot remain at home without meeting scorpions, centipedes, or spiders, or having your clothes, books, and boxes destroyed by moths, white ants, or borers; your eatables devoured by rats, and your drinkables defiled by musk-shrews.

This idea is virtually an enormous growth of exaggeration sprouting from a germ of truth.

I have resided thirty years in this country, and, at various intervals, have encountered all these pests, but with two exceptions, every one of them can be avoided with the most ordinary care. Do what you will, you *must*, in some shape or other, encounter the white ant, or wood-borer, both, enigmatically, most formidable instruments of destruction, and marvellous agents of renovation. The borers I shall dismiss, merely remarking that they are the familiar death-ticks, larvæ of various longi-corn beetles, and that their special function consists in restoring humus to the soil in the shape of impalpable wood-dust; while the function of white ants lies in subsoil ploughing on a marvellous scale; they bring up mud from the subsoil water-level, that is from 8—15—20 ft. below the surface, and distribute it over the land; and, indirectly, they distribute humus from the wood they feed on.

Formicologists reject the white ant from the anty brotherhood, because they say it is a neuropterous insect, while the black ant is hymenopterous; this is very much a distinction without a difference, inasmuch as the white insects are ants to all intents and purposes, but because they are blanched from courting darkness rather than light, the black ants regard them as lawful prey, and devour them ruthlessly whenever they have the chance. And perhaps, too, this hostility is due to the acknowledged superiority of the albino as a mechanical workman of the highest order.

Here this humble insect is *facile princeps* over all orders of creation. No elephant, with his strength and bulk, could go through the patient and enormous labour of the white ant, and what a terrible foe he would be to mankind if he possessed the indomitable energy of the termite in all matters of destruction. Let me explain my meaning. Come with me to this tree, and watch the open end of this delicate mud-tunnel running up its side, and here five feet from the ground. If you have a lens, so much the better. Note the little fringe of antennæ busily at work in finding the proper spot for the little pellicles of mud which you can just see in the jaws of the upside-down workers (all work upside-down while clinging to the roof of their tunnel); that found, you see the pellicle carefully deposited, and then smoothed into position. The process seems simple, but it really means that each humble unit has brought its pellicle of mud from the subsoil* water level, and that, in this

* This level, of course, changes with the season; during the rains it is comparatively superficial, sinks during the cold weather, and is at its maximum at the end of the dry season, just before the rains.

special case, this has involved a journey of 28 feet—*i.e.*, 9 feet to the water level and 5 feet up the tree, to and fro, and that this journey is performed at least 100 times by one pellet-laden termite. Enormous as is his power, and patient his disposition, no elephant could proportionately carry on such work.

Setting aside the tunnel, we are still more amazed when contemplating an ant-hill, and the enormous labour implied therein; for not only does the hill rise from 4 to 6 ft. above the ground, with a circumference of 6 to 18 ft., but its formation rests on the subsoil water-line, whence comes all the moisture used in its construction.

The source of their water-supply puzzled Livingstone, and he hazarded the untenable idea that termites had the power of composing water.

Let us overturn this young hill, the exterior of which is rough with myriads of pellicles of mud deposited from within; immediately a great central tunnel, with a carefully-smoothed interior, is exposed, and around it, minor passages leading directly downwards; if we patiently follow these downwards, we meet a large round or oval mass, exactly like a coarse sponge made of mud, lined with rude paper, and thickly dotted with myriads of small white points, like microscopic fungi; these are the eggs in various stages of development.

In the centre of all is the cell, in which, immured for life, lies the hideous bloated queen, the mother of the busy ant-hive we have disturbed; though she is a prisoner for life, her cell is her royal presence-chamber, and not only is it crowded with workers, but her own royal body is densely covered with them, and it is marvellous how she can bear their weight. Her function is life, that of her progeny, death.

Immured in that cell, personality, or rather individuality, is lost, and nought remains but a living and ever-active matrix, ever extending germs of destructiveness. And the never varying and indomitable resolution with which the foraging expeditions of these are carried out, in spite of all obstacles, is as marvellous as the completeness of the destruction they effect if undisturbed.

As they suffer from chronic photiphobia, all their attacks are carried on under cover, and are therefore the more difficult to guard against. We know how busy a scourer the common ant is; but it works honestly above ground, and in broad daylight; the white ant, on the other hand, lives in eternal twilight, or darkness profound, never shows itself on the surface unless by accident, and then scuttles back underground as quickly as possible. Yet, under these disadvantages, the white ant possesses an instinct for at once detecting the whereabouts of food, which is truly marvellous and inexplicable.

Let me explain. The choicest *bonne bouche* which you can offer a termite is a bit of deal. Nought cares he for the saccharine snares which prove so fatal to his darker cousin. Lay out a bit of deal in the open moonlight, and as sure as you return to it in the morning you will find it covered with ant-mud, and being greedily devoured. Move away the mud, and you disturb ants in hundreds, making as fast as possible for the pinhole in the ground just below the wood, whence they emerged.

Now, how was that bit of wood detected? Let us suppose that it was discovered at night by a foraging termite. Having found the treasure he scuttles back to the hole whence he emerged, conveys the joyful news, as also the proper bearings of the bit of deal, and then a shaft is driven, reaching exactly below the wood. But this is inconsistent with facts, for no choicer morsel exists than a termite, and night prowlers would certainly catch him if he emerged from cover and went foraging about. We are therefore driven to the conclusion that a wonderful and unerring instinct enables the colony to drive a sap directly under the bit of deal.

Again, place a lump of sugar on the beam in the tower whence hangs the church bell, and it may remain there for ages without attracting a black ant; but however thoroughly and substantially that tower has been erected, that beam, and the other beams in that church, have been marked for attack or annexation in true Russian fashion, and as surely will be attempted in process of time by these indefatigable termites. Mark what this means. The church has been constructed of well-burnt bricks and properly-tempered mortar, but a weak point has been found, and there a pigeon-quill-like tunnel is commenced. Bit by bit the mortar is either picked out by the mandibles, or, I believe, dissolved by formic acid, and slowly the sap goes on until a beam is reached, and then the rest is easy. In the case of an ordinary bungalow, built with sun-dried bricks and mud mortar, the thatch and its beams are fully in possession of the enemy before six months are expired.

What is implied in this latter fact? How has that subterranean colony discovered the existence of the bungalow built over it, and how do its inmates know for certain that beams worth attacking are 25 to 30 ft. above their heads? I can only hazard the idea that as "south-east" is the instinctive longing of the Russian hordes, so "excelsior" is the eternal craving of the termite race.

Books and papers are choice subjects of attack, and it is marvellous what irreparable harm can be effected in one night. In our houses we can protect ourselves by keeping everything away from walls, and mounting our boxes on bottles, which they cannot climb, and we place metal discs under all legged or footed furniture.

While on the march we have to be specially vigilant, for our tents and carpets are made of cotton fibre, which white ants simply idolise. Natives believe that termites will destroy anything and everything, and many of their own lâches are laid to the credit of these marauders. I will give a singular illustration of native credulity in this respect, which occurred under my own eye during the Mutiny. The treasurer at Arrah had received orders from the Collector to overhaul the treasure-chest, and gave in his report, in my presence, that the rupees were all correct, except one, which had been eaten by white ants.

Amused to hear this, I asked for the rupee, which was sent for inspection next day; true enough, it was much disfigured, and bore marks as of mice teeth very distinctly, but a certain amount of rust upon it induced me to take a look at the treasure-chest itself, and the explanation of the defaced rupee lay before me; the bag which held it had a slight hole, sufficient to allow a bit of this rupee's edge to protrude: this bit had been in contact with the head of an iron nail in the chest, and galvanic action had been excited —the silver going to the nail-head, and its iron to the rupee. So the white ants were pronounced not guilty.

(To be continued.)

Last week's *Electrician* contains a well-executed portrait of Mr. Willoughby Smith, one of the fathers of ocean telegraphy, and ex-President of the Society of Telegraph Engineers.

The *Dundee Advertiser* states that for a long time it has been known to a few of the leading mining men in Fife that a large area of coal lay between the well-known and extensive colleries of the Perth Coal Company and the Cowdenknowes Coal Company. These fields are about to be opened up by a large limited liability company, and all the latest improvements in mining are to be utilised. The output expected is 10,000 tons a day, and as there is a proved thickness of 151 ft. 6 in.—not including shale—the colliery will last for many years to come and will give employment to a great number of men.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE FOURTH EVENING (*continued*).

"WELL," says the Marchioness, "I hope you will people these four moons, though you say they are but little secondary planets, appointed to give light to another planet during its night."

"Do not doubt it," I replied. "These planets are not a jot the worse to be inhabited, for being forced to turn round another planet of greater consequence."

"I would have, then," says she, "the people of these four moons to be so many colonies under Jupiter's government; they should, if it were possible, receive their laws and customs from him, and consequently pay him a kind of homage, and not view his great planet without paying a deference."

"Would it not be convenient, too," said I, "that they should send deputies with addresses to him? for he has certainly a more absolute command over his moon than we have over ours; though his power, after all, is but imaginary, and consists chiefly in making them afraid: for that moon which is nearest to him, sees that he is 360* times bigger than our moon appears to us; for in truth, he is so much bigger than she: he is also much nearer to them than our moon is to us, the which makes him appear the greater, so that this formidable planet hangs continually over their heads at a very little distance. And if the Gauls were afraid heretofore that the heavens would fall on 'em, I think the inhabitants of that moon may well be apprehensive that Jupiter will at some time or other overwhelm them."

"I fancy," says she, "they are possessed with that fear, because they are not concerned at eclipses. Every one has their particular folly: we are afraid of an eclipse, and they, that Jupiter will fall on their heads."

"It is very true," said I; "the inventer of the third system, I told you t'other night, the famous Tycho Brahe, one of the greatest astronomers that ever was, did not apprehend the least danger from an eclipse, when everybody else was under the greatest consternation; yet this great man had as an unaccountable a fear, did a hare cross him, or if the first person he met in a morning was an old woman, home presently went Tycho Brahe, he shut himself up for that day, and would not meddle with the least business.

"It would be very unreasonable," reply'd she, "when such a man could not redeem himself from the fear of eclipses, without falling into some other whimsy as troublesome that the inhabitants of that moon of Jupiter, of which we are talking, should come off upon easier terms. But we will give them no quarter, they shall come under the general rule, and if they are free from one error, shall fall into another to put them upon an equivalent. But as I do not trouble myself, because I cannot guess what the next error may be, pray clear up one more difficulty to me, which has given me pain for some minutes. Tell me, if the earth be so little in comparison of Jupiter, whether his inhabitants do discover us."

"Indeed," said I, "I believe not; for if we appear to him ninety times less than he appears to us, judge you if there be any possibility. Yet this we may reasonably conjecture, that there are astronomers in Jupiter who, after they have made the most curious telescopes, and taken the clearest night for their observations, they may have discovered a little planet in the heavens which they never saw before. If they publish their discovery, most people know not what they mean, or laugh at them for fools; nay, the philosophers themselves will not believe 'em for fear of destroying their own opinions. Yet some few may be a little curious; they continue their observations, discover the little planet again, and are now assured it is no vision. Then they conclude it has a motion around the sun, which it compleats in a year; and at last (thanks to the learned) they know in Jupiter our earth is a world, every body runs to see it at the end of the telescope, tho' 'tis so little 'tis hardly to be discern'd."

"It must be pleasant," says she, "to see the astronomers of both planets levelling their tubes at one another, like two files of musqueteers, and mutually asking, what world that is? what people inhabit it?"

"Not so fast neither," I replied, "for tho' they may from Jupiter discover our earth, yet they may not know us—that is, they may not have the least suspicion it is inhabited; and should any one there chance to have such a fancy, he might be sufficiently ridicul'd, if not prosecuted for it. For my part, I believe they have work enough to make discoveries on their own planet, not to trouble their heads with ours; and had Sir Francis Drake and Columbus been in Jupiter they might have had good employments. Why, I warrant you they have not yet discover'd the hundredth part of their planet. But if Mercury is so little, they are all as it were near neighbours; and 'tis but taking a walk to go round that planet. But if we do not appear to 'em in Jupiter, they cannot certainly discover Venus and Mercury, which are much less than the earth, and at a greater distance; but in lieu of it, they see Mars, their own four moons, and Saturn with his. This, I think, is work enough for their astronomers, and nature has been so kind to conceal from them the rest of the universe."

"Do you think it a favour, then?" says she.

"Yes, certainly," said I, "for there are sixteen planets in this great vortex. Nature saves us the trouble of studying the motions of them all, and shows us but seven, which I think is very obliging, tho' we know not how to value the kindness, for we have recovered the other nine which were hid from us, and so render the science of astronomy much more difficult than nature designed it."

(*To be continued.*)

* It should be about 1,300.—R. P.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XIV.—THE FRAMEWORK OF THE DWELLING-HOUSE.

GENERAL PRINCIPLES OF CONSTRUCTION—(*continued*).

IN the closing paragraph of our last communication we had occasion to return briefly to the dry system for dealing with house refuse, in order to record the most important advance that has hitherto been made in that department of domestic economy since its inauguration. In doing so, we find that we have anticipated the question asked by one of our readers in a satisfactory manner. The disposal of liquid refuse has heretofore been the only serious drawback to the adoption of the dry method in towns and densely populated districts, and the populace at large undoubtedly owe a debt of gratitude to Mr. Conyers Morrell for his most recent invention, which is capable of rendering all those liquid matters which are subject to decomposition pure and innocuous before they are passed on into the general aqueducts. Not only

would river pollution become impossible by the employment of such a scheme, but the pure waste water may be returned to the earth in localities where its discharge is most needed. This is one aspect of the question which has been very much neglected. It may not be quite so important as the discharge of our debt to the soil, as soil, but it is nevertheless worthy of the consideration of every philosophical student. It has a direct bearing upon the underground water-supply of the country. Man's influence as a geological agent is most marked here. To induce favourable circumstances for his existence, he ought to follow the precepts of Nature; he must return to the earth an equivalent for what he takes from it; he must give back, not only solids, but liquids and gases; he must not merely give them back, because in the end he is obliged to do so, but if he wishes to rank as an intelligent being of the highest order, he must give them back in such a way and in such a place that they may react beneficially upon his surroundings. As a social being, and in his commercial struggle for existence, his activity may be modified, but yet his duty is clear, he must conform to the laws of nature. Sewage utilisation may *prima facie* be looked upon as a theme so prosaic as to be left entirely to the discussion of health-officers and domestic sanitarians; indeed, when we search for the literature upon the subject, we find that it is constituted by dreary reports of committees and technically-written articles which do not even make a pretence to appeal to those ordinary individuals whom it most concerns; whereas, when treated of as it ought to be, and as it has exceptionally been done, the question unfolds itself as of great interest and value to each and every one. We are glad to be able here to direct the attention of our readers to a most clearly-written, instructive, and useful little pamphlet, the title of which, "Our Debt and Duty to the Soil; or, the Poetry and Philosophy of Sewage Utilisation," does not belie its contents.*

Our former remarks upon the dry-earth system have also brought to our notice a new invention which aims at dealing effectively with the sewage of large towns. The principles upon which this contrivance depends are carried out in a novel way. It is so constructed as to dispose of both solid and liquid refuse. The solids are treated upon the dry-earth method, the mechanism being such as to throw a fixed quantity of earth from a divided discharge-box which is worked by an ordinary pull-handle; the material thence lies in a suitable receptacle, and can be periodically removed. But, in addition to this, Mr. Donkin's patent provides for the removal of bedroom and house slops, as well as all fluid excreta which may be directly discharged into it. This is done by a division of the basin of the closet in such a way that soil-waste is separated from fluid-waste. Our contemporary, *Health*, states† that "the urine may thus be either conducted to the drains (though entirely disconnected from them) or to a separate utensil, as may be best suited to individual requirements, while the fæces are deposited in a layer of dry earth, being again covered by a similar charge, and conveyed outside to a receiver provided for it, in a perfectly harmless condition, and deprived of all noxious or disagreeable effluvia."

Thus the appliance is not a copy of any of the existing forms of apparatus, but is original both in its special mechanical details as well as in its mode of action. Its principle is *separation*, and in procuring that it abolishes the liability of harm from the use of wet instead of dry earth, whilst it meets the difficulty to be encountered in a removal of fluid waste.

* By E. D. Girdlestone, Esq., B.A., of Clifton, Bristol.
† August 29, 1884.

To quote once more from *Health*. Messrs. Lawson & Donkin's "Patent Combination Earth and Water Closet" "is not, therefore, a simple modification of any of the present contrivances, but forms an essential difference in the fact of its combining the application of earth and water, and, at the same time, being capable of taking the place of the present water-closet in any class of house or position in it. It may be fixed at practically any height above the receiver, which, in most cases, would be placed outside, level with the ground. It would thus afford ready access for the constant and regular removal of its contents, which, under proper management, is capable of being carried out without the slightest offence to the most sensitive person, while the expense would be more than defrayed by the value of the manure obtained. Some of the granulars prepared from carbonised shale mixed with dry earth are more absorbent and effectual than dry earth merely, and the quantity required of these agents is therefore reduced to a minimum, but they are not necessarily essential, and a mixture of common dry earth and sifted ashes will be found to answer sufficiently well. In any case, it is evident a far smaller quantity will be required than in the case of ordinary earth-closets, where the fluids are allowed to mix with the earth, and all the sloppy masses are avoided, which have hitherto formed one of the chief drawbacks attending the earth-closet system."

THE WEIGHT OF ENGINES.

SCARCELY less remarkable than the growth of railways themselves is the vast increase in the weight of the locomotives used on them. Peter Cooper's engine weighed about a ton. Stephenson's earlier engines sent to this country did not exceed five tons. Twenty years ago, thirty-six tons might be called a heavy weight for engine and tender. To-day, eighty-four tons is not an uncommon weight for a twelve-wheeled "consolidation" engine and its tender, while the Central Pacific Railroad has lately constructed several ninety-three ton engines to haul long freight trains over the heavy grades of the Sierra Nevada. When these iron monsters first appeared, iron rails were in general use. They were often of poor quality, and soon crushed, broomed up at the ends, or even split under the weight and pounding of these ponderous machines. Then came the era of cheap steel, and railroad-managers fondly hoped that their tracks of steel might now truly deserve the English name of permanent way. Steel rails were a great advance in strength and durability over the softer metal, but it was soon found that even steel had limits of endurance.

The monstrous engines of the present day find out every weak spot in bridges and track, and we seem to be reaching a limit in this direction of heavy locomotive construction which cannot be passed without reconstructing our bridges, which were never designed to carry such weights, and replacing the wooden cross-ties with some more enduring material, for these heavy engines crush the steel rails deep into the ties, which are cut long before they decay. Ties of iron or steel have been used to some extent in the old world (where they have been generally made in the form of an inverted trough), but their cost is still a bar to their general adoption. With the ever decreasing price of iron, however, and the increasing cost and scarcity of timber, they may come into general use much sooner than is now deemed probable.—*Railway Review*, Chicago.

THOUGHT AND LANGUAGE.

By Ada S. Ballin.

III.

ALREADY in the early part of the fourth century B.C. philosophers were busy with speculations on the subject of language and its relation to thought. The questions which most agitated their minds were, "Have words an innate relation to their meanings?" and "Did words have their origin in nature or convention?" and it was evidently the fashion then, as now, among a certain school of thinkers, to maintain that language was a divine gift, and, therefore, necessarily perfect; for in his "Dialogue of Cratylus," Plato, speaking through the mouth of Socrates, ridicules the idea of calling in the gods to solve linguistic problems, as actors drag them in on the stage to get them out of a difficulty. He thinks it better to derive words from some barbarous people, or frankly allow that antiquity has cast a veil over them, which prevents us from clearly investigating them, than to say, "The gods gave the first names, and, therefore, they are right."

It would seem from this passage that Plato had some idea of the origin of language in the developing mind of man; and if we pass from Greece to Rome, and skip three centuries and a-half, from Plato to Horace, we find that the ancients had become familiar with a theory of the development of man and language which is practically the same as that which in this nineteenth century of ours is associated with the great name of Darwin.

Two thousand years ago, Horace, in one of his Satires,* set forth much the same view of the origin of civilisation and language as that which I advocated in my last article. The passage is one of very great interest, and I quote it in full from the racy translation of an anonymous writer in the seventeenth century, who seems to have thoroughly caught the spirit of the Roman poet:—

> When in former time
> Mankind, which of all creatures is the prime,
> Crept out of mother earth, they were a kind
> Of dumb and nasty cattle, which inclined
> To brawl for mast,† and dens to lodge in too;
> With nails and fists. And next with clubs; and so
> In length of time they fought with spears and swords,
> Which need had taught them how to make; till words
> And names by them invented were, whereby
> They did their sense and voices‡ signify
> Unto each other. Then they did begin
> To build them forts to dwell with safety in;
> Then they enacted laws. . .

Primitive man, although, as Horace says, "he, of all creatures was the prime," was, we may imagine, but a little superior to other creatures; time, and the sharp stimulus of necessity, were required to bring him up to that standard which corresponds to our definition of man at the present day, when he is frequently defined as "the speaking animal," for there seems to have been a period of his existence when, if we are to maintain the truth of that definition, man was not man at all. If this be granted, it must be allowed that there was a point at which an animal having certain human characteristics became man, and that that point was the time when first sounds were used as the signs or marks of actions or things.

At this period of his existence man was probably far inferior to the lowest savage now on the face of the earth; but even to a modern savage, whose intellect is undeveloped and whose ideas are few, a language complete as we know it would be a useless encumbrance. If an attempt were made to teach him such a one, he would adopt those words which served to express his own simple ideas, and all other expressions would be ignored by him, and, in course of time, lost. Thus, if we were to imagine a perfect language bestowed upon the primitive man, we can easily conceive that it would very soon have ceased to have been a perfect language, being lopped down to his requirements, and having to grow up again in the course of ages to suit the necessities of his successors.

It is better, therefore, from every point of view, to treat language simply as one of the phenomena of evolution which began so many thousands of years ago that we can only guess at its earliest phases, and is still developing, side by side with all other phenomena in that wonderful progress from the lower to the higher life.

Language has progressed from simple to complex, and our guesses at its earliest phases are greatly assisted by a study of its simplest contemporaneous phases. These we find among savages, young children, idiots, and the deaf and dumb, all of whom express certain thoughts by means of inarticulate cries and of gestures.

There can be little doubt that the lower animals also make themselves understood to a certain extent in the same way.

Darwin says that in Paraguay the *Cebus Azaræ*, when excited, utters at least six distinct sounds, which excite in other monkeys similar emotions,"* and other monkeys, from their mode of action, seem to show that they have some means of communication.

A writer in a contemporary, after expressing the belief that dogs have the power of making themselves understood by different tones and quality in their barks, says:—

> I am also convinced that birds can equally do so by varied tones. In my early days an old keeper used to say, when he heard blackbirds giving alarm by their cries, "That is for a fox, cat, or hawk," and on every occasion when I accompanied him to the cover I found his surmises were quite correct. Again, when a pet bullfinch belonging to me is indignant at not being let out as soon as he wishes in the morning, he lets us know by one call, and when he is taken up to be petted he makes another call, but invariably the same call on the same occasion.

In the case of still more insignificant creatures, Sir John Lubbock has been led by his carefully-pursued observations and experiments to believe that ants communicate with one another by means of their antennæ, and their unanimity of action certainly seems only to be explicable on some such hypothesis.

In short, the majority of animals utter sounds and perform movements which probably serve as a rough means of communication; for we cannot believe that these actions take place without some purpose, and it is difficult to assign any other for them.

When we speak of the "dumb animals," then, it can only be in the sense in which, all the world over, men have called those dumb whose speech they could not themselves understand. Thus the travellers of the past used to describe the language of those with whom they met as inarticulate, and more like the noises made by animals than anything else; yet they said that they made very expressive signs. Sophocles uses the word *aglossos*—tongueless—to mean foreigner, implying that all the world who could not speak Greek were practically dumb.

In the same way to this very day the Russians call the Germans *Njemez*—speechless—the word *njemou* meaning dumb.

The ancient geographer, Pompinius Mela, said that, "in Ethiopia were dumb people, those who sign with the head instead of speaking; others whose tongues make no sound; and others without tongues.† And Pliny, taking a similar

* Lib. 1: 3; 99, et seq. † Food. ‡ Opinions.

* "Descent of Man," vol. i., p. 53. † III., 9.

view, says of Ethiopian tribes, "there are some who, by way of speech, use nods and movements of the limbs.*

Of late years we have heard little worthy of credit from travellers about dumb races, and the statements which have been handed down to us from the ancients probably partly arose from misunderstanding, partly from the ancient love of exaggeration. Yet as we study the descending scale of civilisation, we find that the lower we go the more are gestures and inarticulate sounds used to eke out the meanings of words.

Thus Madame Pfeiffer states that the Puris for "to-day" say "day," and touch themselves on the head or point upwards; for "to-morrow" they say "day," and point forward; and for "yesterday" they use the same word and point behind them.†

Dr. Milligan says the Tasmanians eke out monosyllabic words with gesticulations and signs, and that "they observed no settled order or arrangement of words in the construction of their sentences, but conveyed in a supplementary fashion by tone, manner, and gesture, those modifications of meaning which we express by mood, tense, number, &c."‡

Captain Burton, speaking of a tribe of North Americans, remarks that, "Those natives who, like the Arapahos, possess a very scanty vocabulary, pronounced in a quasi-unintelligible way, can hardly converse with one another in the dark; to make a stranger understand them they must always repair to the camp fire for 'pow-wow.'"§

For reasons about to be explained, these statements from travellers must be received with certain qualifications; but there can be no doubt that gestures and facial expression have an importance as forming a part of language which is not sufficiently appreciated, and this must be my justification for devoting the next two or three articles to a systematic review of the subject.

THE REFORMATION IN TIME-KEEPING.‖

By W. F. Allen.

(*Continued from p. 70.*)

A COMPLETE system of standard time was finally devised and submitted in April, 1883, to several railway conventions, assembled to consider other subjects, at which about fifty important companies were represented. The system proposed was deemed practicable, and recommended for adoption, by the railway officials present at these conventions. It involved the total abolition of the use of local time by the public, except at points situated on the governing meridians.

A theory of reform had been under consideration by scientific societies for years, and several systems of standard time had been proposed, founded upon this theory, without practical result. Many investigators of the problem among railway officials and scientists had independently arrived at the conclusion that this theory was the correct one. It was based upon the idea of grouping sections of the country together under the same standard with an even hour difference between the standards of the adjoining groups. "Eastern standard time," which is the standard of the section in which Boston, New York City, Philadelphia, Washington, &c., are located, is simply the mean time of the seventy-fifth meridian west from Greenwich, and the time kept in all these cities is now precisely alike. The dotted lines on the right and left of the diagram represent the mean times formerly kept at New York City and Washington in their relation to "Eastern standard time." If a curved line were projected on one of these dotted lines parallel with the curved line on the diagram, and at the same distance, its relation to the central perpendicular line would represent the relation which solar time at New York or Washington bears to the standard time of the seventy-fifth meridian.

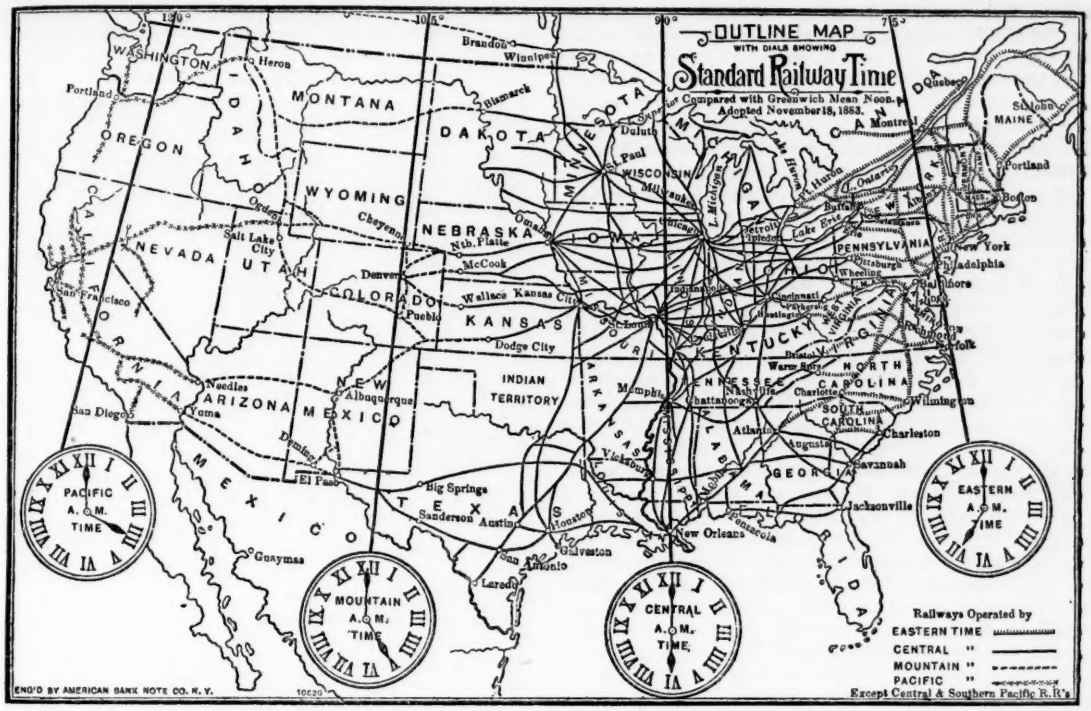
In the various discussions of the question a difficulty arose in deciding upon the best governing meridian. Should it be Greenwich, Washington, or New York? Each had its advocates. If this question could be settled, a more serious one arose in determining the proper lines upon which the sections could be divided. The result of its adoption has proved that the system proposed in April, 1883, solved the questions satisfactorily. This system is now in force, and is represented in outline on the map which appears on our next page. It will be noticed that the dividing lines are irregular. Communities near the border which have adopted the system, use the standard east or west of their localities, according to the direction in which their business interests lie. In other words, the question is determined by convenience of use, as questions in regard to time-keeping have always been determined. The peculiarities of ownership or operation of the railroads determined their points of change. Legislative enactment will doubtless ultimately define the precise boundaries of the sections of countries to be governed by each standard.

The action of the railroad companies having been assured, the subsequent action on the part of city governments became possible, as it could not have been otherwise. Of the labour and means employed to secure this action on the part of the railways and the cities, it is unnecessary here to speak. They proved sufficient to accomplish very fully the end desired. More than eighty per cent. of all the cities of over ten thousand inhabitants in the United States have adopted standard time.

The adoption of the new standard required a simultaneous change to be made in the railway-clocks and the watches of *employés* upon nearly every railroad in the United States and Canada, the change varying from one minute and three seconds on the Pennsylvania Railroad to forty-five minutes on the Intercolonial Railway of Canada. The exceptions were two roads in the vicinity of New Orleans, and a few lines in the vicinity of Denver. The change was also slight for some of the St. Louis roads. The Intercolonial Railway adopted the time of the seventy-fifth meridian as a matter of convenience, instead of that of the sixtieth meridian, to which its location would have properly assigned it. So perfect were the preparations that not a single accident at any point is recorded as having been caused by the change. On the day when the new standards took effect, the clocks of about twenty thousand railway-stations and the watches of three hundred thousand railway *employés* were reset. Hundreds, perhaps thousands, of city and town clocks were altered to conform. How many individuals reset their watches it is impossible to compute, but they could certainly be reckoned by millions. Probably no such singular incident has ever before happened, or is likely to occur again.

At the present time, from the Atlantic Ocean at the eastern extremity of New Brunswick, to the Pacific coast at Oregon, the minute-hands of the railway clocks and watches indicate the same minute of time at all hours, and

* VI., 35.
† "Eine Frauenfahrt um die Erde," p. 102.
‡ Milligan, in Proc. of Royal Soc. of Tasmania, vol. iii., p. II.
§ Burton, "City of the Saints," p. 151.
‖ From the *Popular Science Monthly*.



fully fifty million people regulate their business affairs by standard time.

While a few, and for the most part unimportant, communities, and some railway companies, did not make the change immediately, so large a majority adopted the system on Nov. 18, 1883, that that date may be fairly be taken as the one upon which the reform took effect. Several New England railroads, the Central Vermont Railroad being the most important, commenced to run their trains by "Eastern" standard on Oct. 7, 1883. The Central and Southern Pacific Railroads west of Ogden and Deming, and their branch lines, are the only railroads in the United States or Canada which do not now use standard time, if we except two purely local roads in Pennsylvania, aggregating less than twenty miles in length. The last to adopt the system were the Union Pacific Railway and the city of Omaha, on May 1, 1884.

The legality of the use of standard time was established by the decision of Judge Holmes, of Massachusetts, that whatever time was in ordinary use by the people of any community was lawful time; and his decision is not likely to be reversed. From an economic standpoint it is difficult to perceive what difference it makes to a labouring-man whether he commences work at a time nominally called seven o'clock or half-past seven, so long as he receives full wages for a full day's work.

Some of the objections raised to the use of standard time as a substitute for local time are as amusing as the famous declaration of the Rev. John Jasper, of Richmond, Virginia. It is urged that the sun was divinely set to rule the day, and therefore to use any but solar time is akin to, if not actually, immoral conduct. As the moon was also set to rule the night, such persons, if logical, should obey that portion of the divine command also. The fact is, that solar time was necessarily abandoned when clocks came into general use, and time based upon one or another arbitrary standard has governed the civilised world ever since. The present system, with its widely extended uniformity, simply conforms to the principle of securing the greatest good to the greatest number, a principle which must everywhere in the end prevail.

Editorial Gossip.

If I may judge from the details of some rather remarkable proceedings, reproduced from the American report in our contemporary the *Photographic News*, Trade Unions are, in the United States, by no means confined to artificers. From this account I learn that the meeting of the Chicago photographers was held on Friday evening, Dec. 19, at the studio of Mr. Melander, 208, Ohio-street, in answer to a special call to take action against Mr. Felt. The charge against him was that he had hung out a sign offering to give a coloured panel worth two dollars as a premium to any one who ordered a dozen cabinets of him. "A coloured panel" rather reads as though the peccant photographer had been seeking to oppose the house-decorators, but I suppose that it is the technical term for some particular form of portrait. The numerous speakers at the meeting, one and all, insisted on the necessity of "keeping up prices," Mr. Melander announcing "himself as an advocate for the highest prices that could be obtained"; and, having thus formulated what may be regarded as the Chicago ethics of professional photography, proceeded to action; for, after some further discussion, "a committee was appointed to take down the sign. They proceeded immediately to the performance of their duty, and after the culprit had warned his wife not to be alarmed at any unusual sounds down stairs, the obnoxious sign was hauled down, and soon reduced to an unsightly mass of kindling wood and rags. The affair was taken in the most good-natured way, though it might have easily resulted in much bad feeling but for

Mr. Felt's forbearance." I am, on the whole, disposed to think that if this "committee" had attempted to administer such a form of lynch-law on this side of the Atlantic—say in London—something more than "much bad feeling" would have resulted. The (so-called) "culprit" would appear to have accepted this kind of bullying in a spirit of pusillanimity merely calculated to invite a repetition of similar outrages; and to have been apparently merely Felt, but not seen, during its commission. Had a ring of English photographers sought after the sign of a *confrère* in such a fashion, most assuredly it would have had no sign given it.

It is a long time since I have visited any exhibition at once so novel, interesting, instructive, and amusing, as that of the Japanese Village at Hyde-park-corner. The anthropologist, the student of sociological science, the artist, the mechanic, and the mere sightseer, will, one and all, find material for study and reflection in this reproduction of everyday life in Japan. Whether we are watching the screen-painters, the fan-makers, the embroiderers in gold (with their noses almost touching the satin through which their needles travel), the wrestlers, the graceful juggler, or the unfamiliar antics of the dancers, we feel that we are in a strange world, immeasurably removed, both in time and space, from that which we have left outside the entrance-doors of the building. The aptitude exhibited by these curious people, though, renders it easier to understand the plasticity of their race; and the facility with which western ideas and western knowledge have been assimilated by them.

The mention of the short sight of the Japanese embroiderers suggests to me to invite attention to the valuable and important paper on "The Influence of Civilisation on Eyesight," which was read last week by Mr. R. Brudenell Carter before the Society of Arts. There can be, unfortunately, no doubt that myopia is a visual defect which is increasing in England very rapidly indeed; and that while a comparatively few years since it was largely confined to the literary and professional classes, it is now common in all ranks of life. A report of Mr. Carter's very practical essay (for which we are indebted to our contemporary the *Standard*) will be found in another column.

The appointment of the author of the first of the now almost forgotten "Essays and Reviews" to the Bishopric of London affords a very instructive illustration of the advance of popular thought and intelligence since the original publication of that absurdly-abused book. Even when Dr. Temple was created Bishop of Exeter, the Ritualistic papers shrieked and displayed antics akin to those of monkeys quarrelling over a nut; and now the writer of the essay on "The Education of the World" is to be the spiritual head of the metropolis! Slowly, but very surely indeed, are men learning the utter hopelessness of attempting to sweep back the Atlantic of Science and Philosophy with the Mrs. Partington's mop of Ecclesiastical authority.

Two important and interesting cases with reference to secondary battery patents in the United States have recently been decided. Interferences were raised against the Sellon and Swan patents, which belonged to the Electrical Power Storage Company, by Starr and Brush, and in both cases the fight has been most obstinately, and at great cost, contested for nearly two years, appeal after appeal having been heard. The result of the last appeals are that priority of invention has been awarded to both Sellon and Swan, as against Starr and Brush. As against Brush, the decision on this last appeal is absolutely final; but in the case of Starr a further appeal is still possible.

Reviews.

LIFE IN THE DEAD PAST.*

At a period geologically recent, but which dates back to a hoar antiquity at which the human mind may well stand in amazement, some mighty prototype of the present Amazon or Ganges ran into an ocean where Northern Europe now stands. The fluviatile and estuarine deposits of this stupendous mass of water, which range in patches from the (so-called) Paris Basin and the Netherlands up through Hants, an area of many miles around London, and so on, apparently even up to the north-east coast of Ireland, are known to the geologist under the collective title of the Eocene Formation. With its subdivisions we have nothing here to do. The first part of the noble volume now lying before us, forms the second portion of Vol. II. of Mr. Gardner's "Monograph on the Eocene Flora," and is devoted to the Gymnosperms, of which our modern Coniferæ offer the most typical representatives. Anyone who wishes to see how the history of a vanished world is written and engraven in stones, need only turn over the really exquisite plates with which Mr. Gardner's paper is so profusely illustrated, to realise his desire. They are wonderful as reproductions of the objects they depict, and are really quite stereoscopic when gazed at.

Following this instalment of the initial monograph, comes the first part of another on the British Fossil Bivalved Entomostraca from the Carboniferous Formation, by Professor Rupert Jones, Mr. Kirkby, and Professor Brady. The Entomostraca, as most of our readers probably know, are minute aquatic crustacea; and the Cypridinadæ, which are specially described in the volume before us, are tiny bivalves, which may be roughly compared to mussels with transparent and glassy shells, varying from about the size of a pin's-head upwards. They are found universally in water; from the open sea to the pool or clear ditch on every open space; and that they were equally common and abundant in the dawn of those dim ages of the past when the American swamp of to-day was prefigured by those stupendous areas of vegetable growth whereon our existing supply of coal had its origin, is amply evidenced by the numerous genera and species figured by the authors.

And in that stage of the earth's history immediately antecedent to the time when the land teemed with vegetation of a size and rankness of growth now almost inconceivable, there continued to swim or crawl about at the bottom of the shallower seas, that strange and most ancient type of crustacean, known as the trilobite. To the able hands of Dr. Woodward is entrusted the description of such of these creatures as lived during the time of the deposition of the carboniferous limestone. It was one of which, albeit it is often found in a marvellously perfect state, but comparatively little is known; one reason undoubtedly being that from the way in which they have been fossilised, we are absolutely ignorant of the under side of the body. The minutest detail though of their large compound facetted eyes is quite commonly preserved. The trilobite could roll itself up like our own common woodlouse, and is far from infrequently found in this condition. An isopod dredged some few years since in the South Atlantic, not far from Rio Janeiro, apparently presents more points of affinity with this extinct crustacean than any other living form.

Dr. Woodward's article is followed by the third part of Vol. V. of Dr. T. Davidson's monograph of the British

* The Palæontographical Society, Vol. XXXVIII. Issued for 1884. London, December, 1884.

Fossil Brachiopoda. The Terebratulæ (which, from their stupendous antiquity and range in time, have been called "the fossil aristocracy") are the best-known representatives of this class. The article before us concludes Dr. Davidson's Monograph, and consists of an appendix to its supplement, a general summary, and a catalogue and index of the British species.

The volume concludes with the seventh part of the monograph on the Lias Ammonites, by the late Dr. Wright; the last contribution to the knowledge of a subject on which he was admittedly one of our greatest authorities, that proceeded from his pen. His excellent descriptions, at once scientific and perspicuous, are illustrated by some most splendid lithographic plates, by a Mr. Gawan, which are really so marvellously truthful, and look so solid and life-like (or, in strictness of diction, natural) as almost to cheat the spectator into the belief that he is regarding the originals. On the value—nay, on the absolute necessity—of these volumes to every student of palæontology and collector of fossils in the British Islands, it seems almost superfluous here to insist. So admirably and truthfully are the fossils delineated that are described in the text, as to render such delineations, for all practical purposes, equivalent to their originals for the comparison and identification of specimens. How the Palæontographical Society can issue such sumptuous volumes as this, year after year, for its annual subscription, we wholly fail to see. Any attempt to repeat the experiment on the part of a private publisher would, we fear, result sooner rather than later in an interview with a registrar in Portugal-street, Lincoln's-inn-Fields.

SOME BOOKS ON OUR TABLE.

Mathematical and Physical Papers. By Sir William Thomson, LL.D., D.C.L., F.R.S. Vol. II. (Cambridge University Press. 1884.)—Foremost among those who, during the last forty years, have done so much to advance our knowledge of mathematical and experimental physics, stands undoubtedly the name of Sir William Thomson; and the second volume of his collected essays, now lying before us, cannot fail to enhance a reputation already extending to every part of the world where the English language is understood and scientific information sufficiently diffused to render his writings intelligible. The papers in this volume are collected from various scientific periodicals, and range in date from 1854 to 1878. In the very outset the attention of the reader is arrested by the famous essay "On the Mechanical Energies of the Solar System," which has been since so fruitful of results in, what it is now the fashion to call, the Physics of the Solar System. This is followed by a "Note on the Possible Density of the Luminiferous Medium and on the Mechanical Value of a Cubic Mile of Sunlight," as is that by an article on "Mechanical Antecedents of Motion, Heat, and Light." Two characteristics will at once strike the careful reader of these essays. The first is the value of our author's quantitative determinations of the forms of energy with which he is dealing. The second the truly scientific spirit in which he frankly withdraws any of his hypotheses which he has found to be untenable since he first advanced them. Nothing is so characteristic of the man of science of the highest class as this. It is the sixth, seventh, eighth, or tenth-rate hanger-on to her skirts who, having once promulgated a hypothesis, adheres to it and continues to proclaim it, after its fallacy has been conclusively shown. As may be expected, electricity and the theory and practical construction of the electric telegraph occupy a considerable portion of the work, magnetism also claiming no inconsiderable share in it. A short paper on "The Use of Observations of Terrestrial Temperature for the Investigation of Absolute Dates in Geology" will suggest some pregnant thoughts, too, to the geologist. No one who wishes to trace the steps by which the dynamical theory of heat has been arrived at, or to understand the manner in which our existing knowledge of electricity and magnetism has been built up, can afford to neglect the perusal of the collected works of Sir William Thomson.

Practical Physics. By R. T. Glazebrook, M.A., F.R.S., and W. N. Shaw, M.A. (London: Longmans, Green, & Co. 1884.)—This most recent and excellent addition to the well-known series of "Text-Books of Science" is really, in effect, a reproduction of the contents of the MS. books in which its authors, who are Demonstrators at the Cavendish Laboratory at Cambridge, were accustomed to write out the practical details of the various experiments performed there. Verbal explanations of the principles of physics are, save in certain special cases, almost entirely eschewed, the student being supposed to have familiarised himself with them from the ordinary text-books. Hence its 482 pages are what they profess to be—essentially and eminently practical, and the apparatus employed in the various forms of measurement and the methods of using it are described and illustrated in the fullest detail. Messrs. Glazebrook and Shaw have produced a book valuable alike to the teacher and the student, and one which supplies a real want in our scientific literature. It should be in the hands of every one engaged in the study of experimental physics in the kingdom.

Notes on the Origin and Development of Granitic and other allied Varieties of Plutonic Rocks. By J. Reid. (Edinburgh, 1885.)—Having read in the 1853 edition of Lyell's "Principles of Geology," that molten rocks contract as they pass into the solid state, it occurred to Mr. Reid that so far from granite contracting as it solidified, it more probably expanded—as does water when passing into ice; and he asserts that cast iron seems "to expand at the moment of entering into the concrete state"! Why, if this be so, it does not burst its moulds, as ice does a bottle (or even an iron shell) in which the water from which it forms is confined, he does not tell us; nor why the pattern-maker has to allow as much as $\frac{1}{8}$-in. in every foot for shrinkage in making cast-iron pipes. But what is of the greatest importance, and what he seems to ignore altogether, is, that natural and artificial fusion give wholly different results. If we fuse rock, we get a stony mass outside as it cools, but inside a slag or glass; and modern research has shown that granite could only have consolidated at a comparatively low temperature. It *may* have been pasty, but it never got beyond that stage. As for the expansion of heated rocks, our author might study Vol. XIII. of the "Transactions of the Royal Society of Edinburgh," p. 366.

Water, Preventible Disease and Filtration. By P. A. Maignen. (London: The Author. 1885.)—This pamphlet, by the inventor of one of the best-known and most efficient forms of filter we possess, deals with the subject of water impurities generally, and shows but too plainly over what hotbeds of disease from this cause hundreds and thousands of us are living. The whole subject of water-purification is dealt with, and simple methods of testing it for impurities given.

Packard's Shorthand Reporter and Amanuensis. (New York: Packard. 1885.)—Stenographic reporting has seemingly taken as great a start on the other side of the Atlantic as it has on this. Here is a new journal devoted to the subject, which apparently comprehends biography, blank verse, instruction, and jokes—not omitting, of course,

pages scrawled over with marks suggestive of the proverbial worm that has been trodden on and which "will turn."

The Christmas Hamper. (Rangoon. 1884.)—Here is an orthodox Christmas number which reaches us all the way from Burmah. Seven stories and a poem constitute the bill of fare. Let us hope that the dwellers in that externally charming, though perhaps extortionately dear, station, Rangoon, enjoyed it.

INFLUENCE OF CIVILISATION ON EYESIGHT.

At last week's meeting of the Society of Arts, a paper on "The Influence of Civilisation on Eyesight" was read by Mr. R. Brudenell Carter, who said there could be no doubt, not only that the eye, as civilised men now possessed it, was inferior to that possessed by animals which we had far outstripped in other particulars, but also that, amongst ourselves, it had fallen very decidedly below the standard of excellence which it had attained in some of the families of the human race. An enormously large proportion of the whole German nation is composed of the wearers of spectacles, and there is abundant evidence that the need for such assistance dated from a comparatively recent period. In 1812 the late Mr. Ware communicated to the Royal Society the result of some investigations into the sight of different classes of people in this country, and he stated that, in the three regiments of Foot Guards, short sight was "almost utterly unknown." During twenty years and among 10,000 men, not half-a-dozen soldiers had been discharged, nor half-a-dozen recruits rejected, on account of it. In the military school at Chelsea, among 1,300 children, he found that there were no complaints of short sight, and, on closer investigation, there were "only three children who experienced the least inconvenience from it." Last year, his friend and colleague, Mr. Adams Frost, was good enough to examine for him a Board-school in the South of London, and he found that 73 children out of 267, or rather more than one-fourth, had defective or subnormal vision. Among these 73, 26 were short-sighted, 16 were flat-eyed, and would thus be called upon for unnatural exertion in the act of seeing—exertion which cannot fail to tell upon them in after life, or even before they leave school. In 1865, in Germany, Professor Cohn examined the eyes of 10,060 school children, and found 1,630 of them with eyes of faulty shape. Of these, 1,072 were short-sighted, 139 were flat-eyed, 23 were the subjects of a complicated defect of shape called astigmatism, and 396 were suffering from the results of previous disease. He had offered the School Board for London to undertake an equally extensive investigation, but his offer was declined in an uncivil letter, written in very bad English. He could not doubt, however, from the incidental sources of information at his command, that the conditions found in one school by Mr. Frost would, at least approximately, be repeated in many others. What he might fairly describe as national neglect of the culture of the eyes, and of effort to improve the faculty of seeing, was chiefly due to the prevailing absence of notion concerning the proper range and scope of the visual function, and hence concerning the powers which the eyes ought to possess. Few things were more remarkable than the common want of information about all matters which related to the use and functions of these important organs. In most other respects it might be said that the majority of parents had a fair knowledge of what ought to be the average powers and capabilities of children. They knew, approximately at least, how far a boy of ten years old could reasonably be expected to walk, how high or how far he could jump, how fast he could run, what weight he could carry, what force he could exert. There was not one parent in five hundred who had the smallest notion how large an object—say a capital letter, a boy ought to be able to see clearly at one hundred feet away, or who could tell at what distance he ought to be able to see and describe the characters of an object of given magnitude. There was not one parent in 500 who could tell whether his children possessed natural colour vision, or who, if the inquiry were suggested to him, would know how to discover the truth. Mr. Francis Galton had lately pointed out, with great force and lucidity, that one of the most important duties of man, at the present stage of his development, was to regulate the progress of the evolution of his race; and one consequence of want of knowledge about vision was that the evolution of the eye had been left to the sport of accident, or that it had even been injuriously affected by many of the circumstances incidental to civilisation. Into the operation of these circumstances it was now time to inquire. For the organs of living beings there was no resting-place; they must either advance or deteriorate, either continue in a course of improvement under the influence of evolution, or "throw back," as breeders say, to an earlier and less finished type under the influence of sluggish and imperfect use. Of deterioration we had an abundance of examples, and in two especially common ways. We had the malformation of short sight, which had come into existence within historic time, and into prevalence almost within living memory, and which now affects at least one-tenth of our population; and we had the malformation of flat-eye, which was plainly an involution, a return to an earlier and less perfect type, and which was attended, in the great majority of cases, by an acuteness of vision below even the humble standard with which our dwellers in towns are wont to satisfy themselves. The remedy for the conditions which he had described must be sought, first of all, in a recognition of the fact that good sight is an important point of physical excellence, which, like any other such point, should be assiduously cultivated. He would urge parents to ascertain, as soon as their children knew the alphabet, whether they could decipher the letters at the proper distances. He would urge upon them, in the case of every child whose vision was sub-normal, to ascertain the cause and nature of the defect, and to regulate not only the studies, but also, as far as possible, the future career, in accordance with it. He would urge upon all who had the control of schools, that the vision of every new pupil should be tested on admission, and that the tasks required should be controlled in accordance with its capabilities. He would urge that all lesson-books for very young children be printed in large type, and that the children should be compelled to keep such books at a distance (the type in which we often see texts of Scripture printed to be hung up in railway waiting-rooms would be a good size for the purpose). He would urge that many of the school-books now in use should be abandoned; and that new editions should be prepared, in type of at least twice the size, and twice the legibility (the latter depending much upon the shape and design of the letters) of that which was now in use. Finally, he would urge upon all who were concerned in the organising of athletic sports and contests that excellence of vision should be highly esteemed in such competitions. He felt sure that if public attention were once fairly directed to the question, if the eyes received as much attention as the muscles, and if an intelligent knowledge of what they ought to accomplish were diffused abroad, that our country, in the course of two or three generations, would be peopled by a race who might engage, if not without fear, yet certainly without disgrace, in a seeing contest with any other representatives of the human family.—*Standard.*

Miscellanea.

It was stated last week, at the annual meeting of the Dudley Chamber of Commerce, that Belgian iron is delivered in India at about the same rate as is charged for the conveyance of that kind of material from Dudley to London, which is about 15s. per ton.

A rainfall map has been issued by the Mining Department of New South Wales, showing the borings which have been made throughout the colony for water, not only by the Government, but by private individuals.

From a Government return just issued it appears that in 1883 5,171,963 tons of coal were carbonised for gas-making purposes by companies belonging to other than local authorities, and 2,459,341 tons by those owned by local authorities, or a total of 7,631,304 tons. The quantity of gas produced was 76,837,967,813 cubic feet of gas.

One of the uses to which it is proposed to put the locomotive electric head-light is to have a second illuminator placed on the rear of the engine's cab, throwing a flood of light over the train, and so arranged that it can be turned to the right or left, and be made to illuminate the station grounds when the train is at a standstill.

The *Annales Industrielles* describes cork bricks, which it says are now being employed for various purposes, such as for coating steam-boilers and ice-cellars, and for many other purposes. They are thus made:—The cork is freed from woody particles and other impurities by a winnowing process; the wind from the ventilator throws the cork into a second machine, where it is cut to pieces, and is thence drawn up in buckets and ejected into a mill, where it is ground to an impalpable powder, which is then kneaded up with a suitable cement and pressed into bricks. The cork bricks are first dried in the air, and afterwards by means of artificial heat. They are hard, and not liable to decomposition, and keep off moisture, heat, cold, and sound.

On Tuesday evening, an interesting lecture was delivered by Prof. W. Grylls Adams, F.R.S., at King's College, on the "Electric

Light for Lighthouse Purposes." The learned professor has spent some time at the South Foreland testing the experimental installations there. He described a number of these experiments, but, while indicating many of the advantages pertaining to the electric light, did not contribute anything of importance towards answering the question: Which gives the best light in the worst weather—gas, oil, or electricity?

The Health Exhibition.—At a meeting, on Tuesday, of the Council of the International Health Exhibition, held at the Rooms of the Society of Arts, Sir James Paget, Bart., in the chair, the accounts made up to date were presented, and a probable surplus of £19,000 was shown. It was resolved that, inasmuch as the late Exhibition was only the first of the series announced by the Prince of Wales at the close of the Fisheries Exhibition, the surplus should not be disposed of until the financial success of the International Inventions Exhibition was assured. The question of the distribution of the surplus will, therefore, be postponed till the end of the present year.

A Gardening Hint.—The February operation in the greenhouse is re-potting. All those pots that have been in use before should first of all be washed and thoroughly dried; this again might be a winter operation, done at a time when you thought you were a little slack of work in the garden. The most vigorous growers, and those plants in the most forward state, should first be attended to. And in doing this be particular about the drainage of your pots: cover the little pieces of tile and crocks with a little moss or turf, so as to prevent the soil mixing up with them. And when you find the roots matted as you take out the ball of earth from the pot, very carefully loosen them a little, and pierce the ball of earth so as to allow it water more readily. But the greatest care is necessary to have your new soil filled into every crevice around the ball of earth, which should be placed so deep in the pot as to admit of being just covered over when you are shifting And speaking of soils reminds us that all our different kinds of composts should be kept protected from rain. It is of no good to have them perpetually washed and soaked through, but they should be kept in a dry potting-shed, well turned over, and in a good friable condition for use when required.—*Cassell's Family Magazine.*

Dedicatory Flowers.—In the mediæval ages many of them were associated by the Catholic Church with different apostles and saints. Thus, the Canterbury bell was so named after St. Augustine, of England; the crocus was dedicated to St. Valentine; the crown imperial, which was introduced into England in the time of Shakespeare, to St. Edward, king of the first Saxons; the cardamine, the white lily, an emblem of purity, and the marigold, the petals of which were supposed to represent the glory surrounding her head, to the Virgin Mary. The snowdrop, the "first pale blossom of the unripened year," prettily said by the ancients to be sent by the goddess Flora to ascertain if the cold and frost were mitigated, was called the Purification flower, from its opening in Candlemas. We have also the Lent lily, the herb Trinity, herb Christopher, herb St. Robert, the daisy of St. Margaret, St. Barnaby's thistle, the Peter's wort, and St. John's wort. Culpepper, in his "English Herbal," quarrels with this nomenclature. Regarding St. Peter's wort, he says:—"If superstition had not been the father of tradition as well as ignorance the father of devotion, this herb, as well as St. John's wort, had found some other name to be known by; but we may say of our forefathers, as St. Paul of the Athenians, 'I perceive in many things you are too superstitious.'" As another instance of this superstitious custom may be mentioned the Passion flower, in the form and arrangement of the stamens of which believing Catholics found resemblance to a cross and crown. Amongst the associations, also, of flowers with religion, is the tradition in connection with a small red flower, indigenous to Palestine, where it is very abundant, which is called "the blood-drops of Christ," it being said to have sprung from the blood which issued on the ground when our Saviour's side was pierced. A similar feeling seems to have animated the ancients in dedicating certain trees and flowers to different gods and goddesses. The tall, straight poplar, an emblem of strength and vigour, was sacred to Hercules; the olive, an emblem of peace, to Minerva; the laurel to Apollo; the kingly oak to Jupiter; and the myrtle and marigold to Venus. The amaranth, from remote times, has been an emblem of immortality, for, when dead, its flowers still retain their deep scarlet colour. Achilles' tomb was strewn with amaranths, and the ancients crowned their gods with garlands of them. When Christina, Queen of Sweden and daughter of the famous Gustavus Adolphus, renounced the throne to devote herself to study, she instituted an order of Knights of the Amaranth, whose decoration is a gold medal with an amaranth in enamel, and the motto *Dolce nella memoria.* From the acanthus clustering round a basket upon a virgin's tomb, Callimachus took the idea of the Corinthian column, with its beautiful foliated capital.—*Amateur Gardening.*

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE PSYCHOLOGY OF INSTINCT.

[1578]—Instinct has been defined as the unconscious adaptation of means to ends. This, however, is the external act of the instinctive faculty, not the faculty itself. The latter may be described as a blind tendency to some action independent of any consideration, on the part of the agent, of the end to which the action leads. In an ordinary human action the consciousness is awake, and a number of mental faculties are involved. There is emotion based on a motive or appetency, and setting aflow the physical force which the will (having resolved or chosen to carry out the action) controls on its passage to the muscles; and in this execution of a resolve, the intellect comes into play. A boat-builder, for instance, modelling and constructing a boat, is actuated not only by the motive (the desire of gain, &c.) and by his resolve to act, but all his previous intellectual knowledge as to the proper lines, length and breadth of beam, &c., operates as a guide in this his new undertaking. He is an agent acting from experience and instruction, and with a conscious design and consideration as to the aim or end in view. The principal mental faculties which are involved in his design and work are intelligence, emotion, and volition, or more particularly, practical intelligence, a certain motive, and will in its ordinary use.

Suppose now, however, that the same or a similar undertaking to boat-building (say nest-building) were attempted, but in a manner impulsive and independent, as it were, of volition or control, or of experience, and without consciousness or knowledge of the end in view. In this case, the mental elements involved in the action would be, as it were, obscured or eclipsed, and some peculiarities incident to this observation would be discernible in the action itself. What are these peculiarities? They are simply those which we see ordinarily exhibited in the movements of an automaton; in other words, we should see a listless, invariable, undeviating, unceasing, rhythmical action, having for its evident object the physical well-being of the individual or the preservation of the species. Almost all—perhaps we may say all—of the instinctive actions of the lower animals are connected with their purely selfish or material comforts and requirements. The procuring of food, shelter, and security for their offspring, &c., are the motives or objects of the conduct; and it will be readily admitted that the amount of intellectuality required in the satisfaction of such personal needs is not very eminent. It is absolutely indispensable that the animal should be fed at all states of youth and maturity, that it should be guarded more or less effectually from enemies, &c. The very possibility of animal existence imperatively demands such conditions as these; and it is over these, and these alone, that the wondrous instincts of the lower animals evince power. With man, on the other hand, the case is different. His reason or original practical intelligence is plastic and, as it were, universal. It covers not merely physical needs and indispensable wants, but it embraces in its way innumerable actions and ingenious devices, whose aim is luxury, or mere pleasure, or profit ofttimes superfluous and detrimental.

Reason is, therefore, as it were, independent of life; instinct is closely connected with life, and may be regarded as the practical talent or energy involved in the carrying out of the more necessary processes of life, such as each particular species is peculiarly organised to perform. It is essentially a practical faculty, whose relations to the intellect are not very clear. A human action, not

purely spontaneous, is always guided by an intellectual notion, which is expressly before the consciousness, and whose influence guides, and as it were shines through, the work performed from its commencement till its completion. The notion of a bottle of a certain shape and size directs the movements of the glass-blower manufacturing it. But in the case of instinctive actions, on the other hand, the presence and influence of this intellectual element are not so prominent. In every animal movement, however, there must be a guide or pilot, else its course would be erratic and eccentric.

The grand question, therefore, is, from what faculty or how does this intellectual element in instinctive action proceed? Two answers may here be given—two solutions are possible. One school of thinkers opine that there is some sort of mystery in the matter; that, while instinctive actions come from a dictating energy operating above the sphere of consciousness (*i.e.*, epicto-motor), the intellectual process involved therein is performed for, not by, the animal, and proceeds from an overruling mind or purpose outside itself. Another school of psychological zoologists maintain that instinctive actions are really organic. The nerve-ganglia (they say) can retain traces or relics of impressions brought to them by the nerve fibres, and they also delay the impression, so that it inter-acts with other impressions. In this way the nervous system can modify the impressions, and convert them into different results, thus producing those actions we call instinctive. The nervous mechanism thus forms itself according to the mode in which it is habitually exercised; and intellectual forces or tendencies to action become, as it were, embodied in the nerve-ganglia or cells. From this point of view, the nervous system (in combination with the muscles) may be regarded as a highly sensitive and plastic organ of practical energy, which, through long usage and custom, is constrained to move in a certain fixed, unvarying groove or channel. And if it be maintained that instinctive actions are inherited experience, it may be observed, in reply, that the design or fixed intention which they exhibit has originated from a low form of mechanical talent, and not from any of the loftier powers of mind which imply thought, ratiocination, and ideal generalisation.

P. Q. Kegan.

[Dr. Kegan appears to ignore the fact that many actions, either having their origin in volition or in a slow and painful education, ultimately become what we call "instinctive." Walking is a familiar one. Note the struggles and falls incident on the incipient attempts of a child to balance itself when first set on its feet, and compare it with the absolutely automatic progression of the grown man. I can, and do continually, walk along an indifferently-made road, reading every foot of the way, without even stumbling; and soldiers have been repeatedly known to sleep on the march. Nor does our correspondent seem to attach sufficient weight to inherited memory as a source of what is called instinct.—Ed.]

OUR TWO BRAINS.

[1579]—Mr. Jos. W. Alexander's account of an accident to a boy whilst playing cricket on Brighton Downs, reminds me of a similar experience on the football field some years ago.

Play had proceeded for about ten minutes, when an opponent charged me at full speed, as, in the act of kicking the ball, I was standing on one leg. I was thrown heavily, the back part of my head and neck first touching the ground.

Although I played the whole afternoon so that no one knew anything was the matter, and played with evidently no loss of energy or skill, as my services received special mention on the occasion, I have no recollection whatever of anything that occurred between receiving the fall and coming-to again a few minutes before the call of time.

In those days it was customary to change ends at every goal, as well as at half-time.

When I began to recover I was running at full speed with the ball, and my first sensation was one of dismay to find myself unaccountably running in what appeared to me to be the wrong direction. In my confusion I left the ball and ran aimlessly about for a second or two as though striving to go in both directions at once.

At first I could not remember where I was, or what club we were playing, and had to ask for information from one of the players. After receiving the answer I remembered everything up to getting the fall. I then asked whether, as we were playing from the opposite end, we had gained or lost a goal, and obtained the information that it only wanted a minute or two to time, and that no goal had been obtained by either side during the afternoon, the reason we were playing in the opposite direction being simply owing to the change at half-time.

Thus was passed some seventy or eighty minutes in movement of the most active and varied as well as arduous kind, and although unconscious all the time no one was able to recognise the fact, or ever would have known it, had I not been obliged to ask for information.

C.

MIND AND BODY.

[1580]—"An Earnest Thinker," in letter 1,574, enters widely on the field of theology, which I do not, in accordance with your rule, wish to enter. I merely wish to correct his statement of what I wrote, viz.: given an "almighty will," free will cannot logically exist; a will that is "free" cannot be under control of another will; a will that is "almighty" cannot be limited by "a will that is free."

So must "providence" exclude "accident." Where there is a providence providing for everything, accidents cannot occur, for the very meaning of accident is something that happens by chance, *i.e.*, is not provided for. I feel almost ashamed to put such obvious truisms before your readers.

Mr. Jos. W. Alexander, letter 1575, says, referring to a previous letter of mine, "that consciousness is not a function of the brain—no more than the image in a looking-glass is a function of the object reflected." This is no comparison at all. If "J. W. A." will draw a comparison between brain and a looking-glass, it should read thus:—Functions of the brain: volition, consciousness. Functions (or, as I would prefer to say, properties) of the looking-glass: reflection, smoothness. If the brain is injured or inactive volition and consciousness are affected or cease. If a looking-glass is broken or the quicksilver removed, the reflection becomes imperfect or ceases; if roughed, the smoothness is gone. "J. W. A.'s" queries I will answer when he tells me what his "soul does when unconscious," or what it can do without eyes to see, ears to hear, nose to smell, tongue to taste, nerves to feel, and brain to think!

F. W. H.

THE BEGINNING OF THE MIND AND THE END OF THE MATTER.

[1581]—Many years ago, a Cambridge graduate wrote to me, asking why I thought it necessary to have a soul in order to think, when I did not consider it necessary to have a soul to enable my liver to produce bile. I replied that I was so ignorant as to the connection of mind and matter that I could not say whether my liver could produce bile without the aid of my soul; but, for argument's sake, I would grant that the liver did produce bile without any such aid; but I said, at any rate, you must allow that the proper function of a healthy liver is to produce healthy bile, and the proper function of a healthy brain is to produce healthy thought. What, then, concerns us is to discover what is healthy thought. I maintained that healthy thought was the thought of the wisest and best of men throughout all past time, and that the conception of a God, of a soul, and of a future life was the result of such healthy thought, and, therefore, properly represented the actuality of such a Being, of such a soul, and of such a future state. I might have gone further. With the exception of one or two very savage tribes, such thoughts have been the outcome of the brain of every race of man.

The almost universal belief in a Supreme Being, in a soul, and in a future state is, I think, the strongest evidence upon which to build up our belief on those subjects. Again, we cannot increase or decrease matter. We but change its form; but surely thought, the product of brain, being greater than matter, cannot be dissipated. May we not alter Shakespeare's lines thus:—

"We are not stuff as dreams are made on,
And our little life's not rounded with a sleep."

Many years ago, I was disturbed by a remark made by Mr. D. Stewart in his "Outlines of Moral Philosophy." He there states that the decay of the mental faculties before the decay of the body is the strongest argument against the immortality of the soul. I was perplexed; but my perplexity was removed by hearing a lady playing on a piano. There, I said, is the whole subject explained. My body is represented by the wooden part of the instrument. The chords represent my mental faculties; the musician my soul. Let the chords be in tune, and the musician can produce harmony. If out of tune or broken, though her skill is the same, she is unable to "discourse sweet music." It is true that while the instrument is being tuned, or undergoing repair, the musician is conscious of all that is going on.

This is not the case with the soul, the spirit, the mind, or by whatever term you may designate the intelligence within us. When the mental faculties are injured by a blow, or suspended, as in the case of partial drowning, the soul is unconscious of what takes place during such injury or suspension; but when the soul resumes its activity there is the phenomenon of the continuity of existence. It is the same "Ego." The past is, with the exception of the

time of unconsciousness, fully recalled. The restored man has no doubt but that he is the same person. Mind can thus exist apparently apart from matter. It is, however, unable to give proof of its existence except through a sound, healthy, organised body.

It is fanciful to suppose that nature, or, to write more explicitly, the God of Nature, has so formed man that when his spirit enters a glorified body there will be a complete remembrance of the life passed in his mortal organism, but altogether free from all recollections of the loathsome dissolution of his frame in the dark and silent regions of the grave? If so, what a benevolent arrangement! and surely, if there be a future state, may we not conclude, from analogy, that there will be such a forgetfulness, seeing the unconsciousness of all circumstances that take place during a temporary suspension of the functions of the mental faculties? I fear I have trespassed upon your space, but I hope you may consider the subject not altogether unworthy of it, and that my thoughts may lead others to think out the subject more fully.

Barbados, Jan. 4. W. H. JONES.

SHAKESPEARE AND THE CIRCULATION OF THE BLOOD.

[1582]—Will you kindly allow me to place before the readers of your valuable paper the following facts. Harvey discovered the circulation of the blood in 1628, Shakespeare died in 1616, and in his tragedy, "King John," Act 3, Scene 3, are found the following words:—

"Or if that surly spirit, melancholy,
Had bak'd thy blood, and made it heavy, thick
(Which else runs tickling up and down the veins)."

In several other places, too, Shakespeare mentions the "coursing" of the "blood" through the veins. The only conclusion I can come to, taking these facts into consideration, is that the blood was supposed to travel through the veins before the time of Harvey, and that he simply proved it. If so, the appellation "Discoverer of the circulation of the blood" is rather misleading. Perhaps some of your readers can give a little elucidation on this point. H. TOMKYS.

[All that Mr. Tomkys's quotations seem to prove is that Shakespeare (in common with a large number of people even in remote historical times) was aware that the blood was in motion. Why, Galen knew this much more than 1700 years ago, but his ideas of the *direction* of that motion were grossly erroneous. And it was not until 1543 that Vesalius overthrew the erroneous conceptions of the great anatomist of Pergamum. Servetus (whom Calvin burned) discovered the pulmonary circulation, as did Nealdo Colombo independently, six years after that thoroughly Christian (?) proceeding. Moreover, Cæsalpinus actually used the phrase "circulation of the blood" in a treatise published during Shakespeare's lifetime. What Harvey did was to trace the course of the blood from the left side of the heart, through the arteries, into the capillaries, and so back by the veins to the right side of the heart, whence the pulmonary artery carries it to the lungs to be purified and returned by the pulmonary veins to the left side of the heart to recommence its circuit.—Ed.]

PREHISTORIC SEPULTURE.

[1583]—To "Kirkdale Cave" (1566) I hasten to explain that I never doubted that there are many sepulchral cairns and barrows which were built for that purpose alone, and could never have served as houses. The one he opened on Dec. 24 is one of these; but not, apparently, in any way a *megalithic* structure, the largest stones being but two feet long, which is nothing. These cairns were probably built in historic times by races relatively civilised, as their contents tend to show; but the cromlechs, tumuli, &c., built of enormous blocks, and always possessing *a communication with the air*, were most likely made by men who had no idea of pottery, perhaps not even of flint implements. HALLYARDS.

THE SENTIENT WORLD.

[1584]—In your issue of Jan. 16, Mr. Cave Thomas states that "colour and sound are not images of external things, of mechanical vibration," which is, of course, perfectly true, but he goes on to remark that there is a "world of sensuous experiences which have no resemblance whatever to our conception of outer things, a world of experiences which neither resemble subject or object, a world which science cannot analyse." This seems to need explanation. For surely from the "world of sensuous experiences" are *constructed* all "our conceptions of outer things," even of those "mechanical vibrations" which are supposed to give rise to the sensations of light and colour. Except by sight and by touch we can gain no idea of a vibration or any material object, and science has nothing to deal with excepting those very colours, sounds, tastes, touches, odours, thoughts, passions, pains, and pleasures which Mr. Cave Thomas declares to be outside its province. That it cannot analyse them is, in one sense, true, but they are the materials with which it builds, and with which it forms a concept ("frigid" or otherwise) of "external existence." Thus "subject," "object," and "mechanical vibration," come under the same category with "sensuous experiences."

In reference to your notice of my pamphlet "What is Religion?" and to your notice of Dr. Lewins' letter and my own, may I be permitted to say that Hylo-Idealism differs from previous systems in being a unification of Materialism and Idealism. I may give as its two complementary mottoes "Cerebrum cogit, ergo est," and "Tot cerebra, quot mundi." C. N.

QUESTION FROM FLATLAND.

[1585]—A line is bounded by two points; a surface is bounded by line or lines, meeting at an angular point or points; a solid (in your world) by surface or surfaces, meeting at an edge line or lines, and these at a corner point or points. Therefore, so must a *sursolid* (to use a word twe or three centuries old), or *four-dimensioned* thing, be bounded by solids, meeting at surfaces, which meet at lines, and these at corner points.

Now, assuming four-dimensioned space, but avoiding anything curved, what must you infer to be (1) the smallest number of rectilinear solids to enclose a sursolid? (2) These meeting at how many planes? (3) Which meet at how many edges? (4) And those at how many corners? A FLAT.

THE ANORTHOSCOPE.

[1586]—I cannot say whether the Anorthoscope is on sale, but I have one that was on sale twenty-five years since. I have none of the discs that were then sold with it, but I well remember the playing-cards, the comic head, and bunch of flowers. At that time I distorted a likeness of Burns, which came out as five good likenesses, but that is gone, and I have now only a curious curved figure that shows as five isosceles triangles. Perhaps "F.R.A.S." would like to know that I distorted a figure on horseback three instead of five times. When showing this the cord is not crossed. Both discs turn the same way, and the figure is shown three times repeated instead of five times. And very curiously the figures are turned completely round, both horse and rider facing the left instead of the right, as on the original. I have this now, but never heard of any one else making it. I will willingly show my instrument and discs to "F.R.A.S.," or any one he or you may send, but certainly will not sell anything. N. W. SMITH.

VEGETARIANISM.

[1587]—I am sorry to see so eminent a chemist as Mr. M. Williams support this delusion. There was a party of Europeans exploring Australia (Leichhardt's?) who were found dead, with their stomachs full of food, but starved; they could not digest what the natives lived on. I had an uncle who was a vegetarian for fourteen years; very ill at last, he was pronounced dying of starvation. A pigeon was administered, and this led the way back to mutton and convalescence.

We made the railways in the north of France. At first the contractors—for gain's sake—employed local labour; they were obliged to give it up—also for gain's sake—because they found that one beef-fed Briton did the work of three Frenchmen stuffed with bread and cabbage. If we are to thrive on vegetables, we should spend as much time on browsing as the herbivores all do. How would the City go on if luncheon took several hours? When I was a crack-brained Puseyite of nineteen, I spent a whole Lent on vegetables, save Sundays, feeling no privation or regret. My cheeks, however, permanently lost their due roundness, and the next year I nearly died. I do not like flesh so well as other foods, but I find it absolutely essential, not only to avoid suffering and danger from heart disease, but also to effect digestion of other food. Monks and friars are all deprived of flesh, because they have taken upon themselves to live a life for which a normal man would have too much blood.

After a too long Turkish bath once, I was seized with vomitings, which threatened collapse. I was staying with a physician, and he tried all the resources of the art without avail. At last, I

said I thought a mutton-chop would stop the nausea. He greeted this with a pitying smile; but, being at home, I immediately ordered one. I ate it, and was all right in five minutes.

"Experientia docet melius quam mille magistri."

Hallyards.

LETTERS RECEIVED AND SHORT ANSWERS.

Bemrose & Sons. Received.—Henry J. Madge asks Mr. W. F. Allen if he will show how much of the equation of time is referable to the obliquity of the ecliptic, and how much to the eccentricity of the earth's orbit?—F. Farmer. I have not the least idea of the name and address of the gentleman who had back numbers of Knowledge to sell. I noticed his communication and tore up his letter straightway. Were you to advertise that you wished to buy such, he might probably communicate with you.—J. F. Hobart (?). Be good enough to read the reply to "F. T. B.," with which the "Letters Received and Short Answers" commence on p. 38.—R. W. Pope. Not yet published.—Dr. Groth. You have no one whatever but yourself to blame. Your letters were addressed to The Editor of Knowledge, and in your reproduction of them and the replies to them (omitting, by-the-bye, that on p. 452 of our last volume) you are guilty of the gross breach of literary etiquette of mentioning the gentleman you merely suppose to have written such replies by name. What would be thought of the taste and gentlemanlike feeling of a person who, having invited Editorial comment on letters sent to the *Times* or the *Standard*, were to reproduce his communications, and such comments, under the heading of "Correspondence between Mr. Smith and Mr. G. E. Buckle—or Mr. W. H. Mudford," as the case might be? As a matter of fact, Mr. Proctor was some 4,000 miles off when your communications reached this office, has never set eyes upon a single one of them, and is absolutely innocent of having answered them. I must insist upon your *immediate* withdrawal of his name from the heading of your pamphlet. It is utterly unjustifiable.—J. B. N. informs "Sigma" that lime-water will effectually neutralise the free acid in rancid butter, and thus make it sweet.—D. H. I cannot make head or tail of your quotation from Norie's "Navigation." Astronomers have always commenced their day at the instant when the sun's centre is on the meridian. For example, 9h. 30m. a.m. civil time on January 1, has invariably been known as December 31, 21h. 30m., and it was not until the first of the current month that the Astronomer Royal at Greenwich began to reckon the astronomical day coincidently with the civil one, by putting its commencement twelve hours back. See p. 486 of the *Nautical Almanac* for this year.—Protea. The great red spot on Jupiter, has definitely disappeared for more than a year in all ordinary telescopes, but it was still perceptible in April last in the great 18·5-inch Achromatic of the Dearborn Observatory at Chicago. The reason why different spots give differents rates of rotation of the planet is simply on account of their actual drifting *inter se*.—Thos. J. Savage. I was careful to recognise the merit and sound common sense of your suggestion anent printing the value of all postage-stamps boldly and conspicuously on them. As far as I understood the rest of your letter, it appeared to me to consist of the contention that because, after a lapse of years, the Queen's features would alter, that hence, it was useless to attempt to give a portrait of her at any given date; and that the present head of a youthful maiden should be retained. As it is impossible that you can have expressed yourself obscurely, it must have been my stupidity which caused me to misinterpret your meaning. Have you ever seen the 3 cent. Newfoundland stamp?—M. V. The sun is certainly *not* due east at 6 a.m., or west at 6 p.m. all through the year. He will be so very approximately at Greenwich this year on March 20, and September 22; but on June 21 he will be 15° 7′ north of east at 6h. a.m., and as much N. of W. at 6h. p.m.: a condition of things precisely reversed, in the sense of his being as much south of east, on Dec. 21.—A Chairman of School Board asks Mr. Mattieu Williams to recommend a simple and cheap catechism of cookery for school girls.—Fred. W. Foster. I am most sincerely obliged to you; and have forwarded your communication to the proper quarter, in order that the valuable hints contained in it may receive the attention they merit.—Dr. Kegan, A. Jukes Allen. Received with thanks. Undoubtedly the day is to commence all over the world at Greenwich mean midnight, and this is the time that clocks everywhere must show for scientific purposes. Whether any local concurrent, or, so to speak, vulgar time will also be kept, though, for the ordinary purposes of life may be a matter for discussion. I should think that there must be; at all events at first.—W. A. Thanks; but it is a subject with which at least two members of our staff are competent to deal.—A. Saul has made a pair of Bell's telephones from the directions given in a book—but cannot make them speak; and asks for hints in working them. As I have never seen the directions referred to, this would be somewhat difficult. Sprague's "Electricity" embodies as good practical details concerning the construction of the telephone as you are likely to get anywhere.—M. E. Mavrogordato. How can I possibly explain a most abstruse mathematical question within such limits as are here prescribed to me? See Glazebrook's "Physical Optics," pp. 325 to 331.—Poulton-le-Fylde and M. J. H. The *New York Times* article is a not particularly brilliant specimen of joking upon a small substratum of fact. Everybody knows that the images of objects persist on the retina in *time*, *e.g.*, a burning stick whirled round looks like a circle of light. A similar persistance in *space* on the retina is known as irradiation, and, in virtue of this, all bright objects appear larger than they really are. You can demonstrate this very easily by taking a sheet of white and a sheet of black paper, and cutting out a disc from each of precisely the same diameter, say one inch. Then the black disc is to be pasted upon a sheet of white paper, and the white disc upon a black sheet. If now we regard these two discs, the white one will seem notably the larger of the two, since its image encroaches on the dark background, while in the case of the black disc the white background encroaches on that. For the same reason, the white disc continues visible at a distance whence the black one cannot be seen. Hence it is true that any one dressed in white does appear slightly larger than when clothed in black. The paragraphs concerning the fat woman, the New York cars, the steamer, and the battering-ram, belong strictly to the category of the anecdote of the gentleman who ran so fast round a tree that he saw his own back.—Truth will Prevail. A quasi-communistic book is sent to this journal for review, and is handed for notice to a reviewer I supposed, from his knowledge of Sociology, to be competent to judge of the questions discussed in it. Is he merely to prophesy smooth things, or to give a candid and unbiassed opinion of the work? You are under an entire hallucination as to my being "in the Tory camp." I have the most supreme contempt for party politics. Pray obtain and read forthwith "The Man *versus* the State," by our greatest English thinker, Herbert Spencer. You can buy it for a shilling.—The Duke of Northumberland. Received.—Paterson & Cooper. Received.—Student. I am ignorant where the present series of Gilchrist Lectures are being delivered. Can any reader inform our correspondent? It seems to me that the Gilchrist trustees take singularly little trouble to make the localities of their lectures public.—E. R. Edis. "Spirits of salts" is really an aqueous solution of hydric chloride; which, in the old chemical nomenclature, was known as hydrochloric, or muriatic acid. It does *not* contain any zincochloride. The latter is added to it (as workmen say) to "kill it;" and such "killed" hydricchloride forms, I fancy, "Baker's fluid," sold for soldering purposes.—A Beginner. The only method of rigidly measuring the area of a sun spot is by the aid of a micrometer; but this is out of the question with a 3-inch telescope not mounted equatorially. A very fair approximation, however, may be made in the following manner. If you will refer to page 178 of Vol. IV. of Knowledge, you will find a description of the method of viewing the sun by projecting his image on to a sheet of cardboard. On such a sheet, then, describe a circle of 4 in. radius, or eight inches in diameter, and divide such diameter into 32 equal parts, each, of course, ¼ in. long. Through them rule parallel lines. Now cross them with 32 other parallel lines, also ¼ in. apart, at right angles to the first ones; then shall we have our 8 in. circle cut up into little squares, ¼ in. each way, or the $\frac{1}{16}$th of an inch in area. The image of the sun is to be thrown upon this, and the card and the focussing-tube shifted about until the sun's image precisely coincides with, and exactly covers, the circle. Now, at the earth's mean distance, the sun's angular diameter = 32′·04. So that each of our divisions will represent 1′ very nearly indeed. But on the sun's surface (at his mean distance) 1′ = 27,018 miles and a "square minute," of course, 729,972,324 square miles. Hence, by noting how many of our squares and parts of squares, a spot, or group of spots fills, we can determine its dimensions. The angular distance between two stars in the sky may be determined with a sextant; on a celestial globe with the flexible quadrant; and by trigonometrical calculation from their places in a catalogue. If you know anything of trigonometry I will willingly explain the last-named method.—Uncle John points out that the quotation from Shakespeare in Knowledge for Jan. 16 (p. 51) is from "Hamlet," act ii., scene 2, and should be: "Doubt thou the stars are fire, Doubt that the sun doth move." Pray don't be timid.—D. Francisca de Barros e Cunha. Subject to the due acknowledgment of which you speak, I shall be very pleased indeed to grant you permission.—Rev. J. M. Brackenbury. I have communicated with "F.R.A.S." on the subject, and he says, in reply: "The width of the slots in the black disc of my anorthoscope is exactly 0·2 inch," whence it is pretty obvious that you have hit upon the right cause of your preliminary failure.—Miss C. A. Martineau. Thanks, but our columns are just now somewhat overcrowded as it

is.—E. L. G. Next week.—Chas. Dibdin. Received. There is no more valuable or meritorious institution in the kingdom than the Royal National Lifeboat one; but it is impossible to make the columns of a journal devoted simply to science the channel of any special charitable appeals. — W. Grandy. I cannot even read it; what looks like *v* being probably meant for *ν*, and *γ* written for (presumably) *r*. It seems all participles, and is certainly untranslatable in its existing form. Whence did you get it?—Thomas Ayers. Will you indicate in what "processes of chemical change" the heat generated in a wire hammered on an anvil has its origin? The *Yarmouth Gazette* is, I regret to say, unknown to me. I hear of it now for the first time. —Dr. Lewins points out, in connection with letter 1573, p. 94, that, in line 24, "protoplasm" should be "proplasm," that "œtiology" is misprinted for "ætiology," and "intercraneal" for "intercranial." I am not particularly concerned to defend the compositors (who don't always treat me with that loving-kindness which I regard as desirable); but really your terminology is so comparatively novel that they, who are used to set up paragraphs "plainly worded," may well be forgiven for a slip or two.—Excelsior. I have no recent ephemeris of Encke's comet at the place whence I write. You cannot see it though in a 3-inch telescope. It is, I fancy, in Pisces. It will be in Perihelion about 4 a.m. on March 8. —S. L. B. Of Messrs. Khrone and Sesemann, 8 Duke-street, London, W.

Our Inventors' Column.

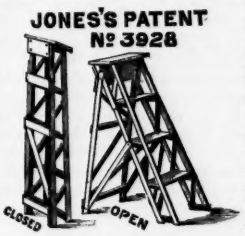
We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (Knowledge *being a popular magazine*) *than is accorded by the most excellent trade journals.*

CHAMPAGNE WIRE-CUTTER.

[Patent No. 1,642. 1884.]—Of all the silly, stupid, and absurd things ever patented, this seems to be the silliest, stupidest, and most absurd—at first sight. A little thought, however, shows it to be not only very ingenious, but equally useful. Champagne is a wine which, as is well-known, requires to be well and securely corked. In consequence of this, the cork is generally fastened on with string, which, however, is liable to rot. String is, therefore, never trusted alone, but is mostly accompanied by a binding of stout iron wire, so that, if one fails, the other may still serve to keep the cork in its place. Some firms are satisfied with the wire binding only, although they stand a chance of losing their wine if the iron should happen to get rusted through. But inconvenience and danger, often resulting in serious accidents, are experienced in breaking the wire with knives, nippers, or carving forks; and even these instruments are not aways at hand at the right moment. Mr. Maignen, of London, and M. Moquet, of Rheims, have, therefore, introduced their cutter, which consists of two flat pieces of metal cut into the shape of a fish, and rivetted together near the position of the fish's eye. Holes are made about a sixteenth of an inch in front of the rivet, and through these holes the wire is made to pass in binding the cork. The position and shape of the "fishes" are indicated in the central figure. To cut the wire, all that is necessary is to draw the fishes apart by their tails, as shown in the upper figure. The leverage introduced by this means breaks the wire very readily. The inner sides of the fishes have pieces cut out of them, which allow them to act as cigar-cutters, in the manner shown in the lower figure. Presumably, the cost of this piece of apparatus is but a fraction of a penny, and can, therefore, add practically nothing to the cost of the wine. It is used solely by Messrs. Montigny & Co.

THE HATHERLEY STEPS.

[Patent No. 3,928. 1882.] The accompanying illustrations almost explain themselves.



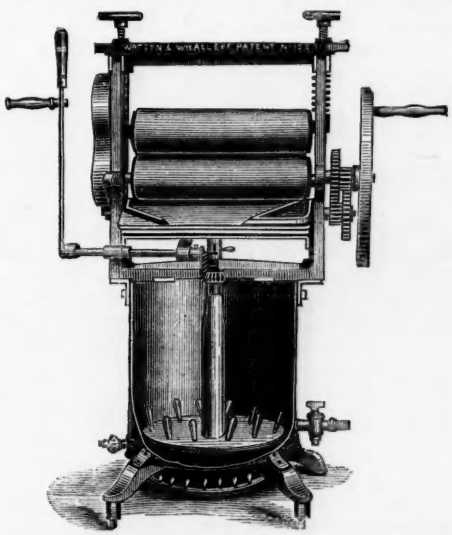
They represent an ingeniously-designed pair of steps, patented by Mr. C. A. Jones (who has entrusted the manufacturing rights to Messrs. Matthews & Co.). It will be seen that by skilful disposition of the material the weight has been reduced to an exceedingly small amount, a very decided advantage for domestic purposes. They contrast strongly with the heavy, clumsy style generally adopted, and one has only to bear in mind the mischief wrought by the old form in the library, the dining-room, and the drawing-room to see the advantage pertaining to the invention. A pair 2 ft. 8 in. high weigh under 5 lb., and can, therefore, be sent by parcel-post! Other sizes are, of course, made, and the better-finished specimens have an appearance highly recommending them to owners of libraries. They are exceptionally strong, being able to bear the weight of a man on each step.

RAISING SUNKEN VESSELS.

[Patent No. 825. 1884.]—Mr. W. P. Thompson, of Liverpool, has patented on behalf of Mr. R. W. Doherty, a device for raising sunken vessels, which consists in the introduction of a number of flexible bags into the ship, and then inflating them with air supplied through detachable pipes, by means of an air-pump carried on board a pontoon. When the requisite amount of air is introduced, and a corresponding volume of water, therefore, displaced, the vessel rises to the surface.

WASHING-MACHINE.

[Patent No. 1,950. 1884.]—This machine is patented by Messrs. Watson & Whalley, of Keighley. It is in its construction and action very simple. The clothes are briskly agitated, by moving the upright lever backwards and forwards, by a dolly-head, furnished with pegs so constructed as to minimise the risk of tearing the



clothes. Gas-jets placed under the machine furnish means for boiling or steaming the clothes. Mangling may also be performed with the machine, which is provided with rollers coated with delta-metal, a substance which is exceedingly tough and durable, takes a brilliant polish, does not oxidise or rust, and which "produces a gloss on the clothes equal to hand-ironing."

Our Chess Column.

By Mephisto.

THE British Chess Association is now an accomplished fact. It is constituted under the presidency of Lord Tennyson, three vice-presidents, and a council of twenty-one members.

The main objects of the B. C. A. are: 1. The promotion of the theory and practice of Chess in all its branches; 2. The conferring of degrees for distinguished pre-eminence in any branch of Chess, or otherwise, at the discretion of the Council, namely, Master and Fellow of B. C. A.; 3. The holding of Chess meetings in the principal provincial centres of the United Kingdom.

Amongst the items set forth (as yet merely by way of promise) in the programme for 1885, are: 1, a National Tournament; 2, an International Problem Tournament; 3, the establishment of a Cup for competition among clubs; 4, other inter-club matches. The Council will act wisely in making the third item their first and chief business, followed by the inauguration of its first annual tournament. Problemists certainly deserve attention, but an International Problem Tournament on a large scale in the first year of existence of the B. C. A. would be uncalled for.

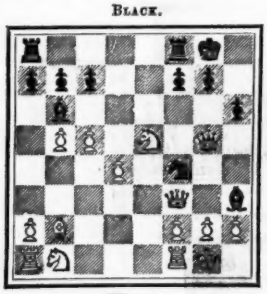
The subscription for clubs for all the benefits promised is very low indeed, being 5s. for every twenty-five members. Individual subscription is 5s. per annum, and as the society will largely depend upon this source of income for funds, we hope Chess-players will not fail to enrol themselves. Life membership of the B. C. A. is obtainable on payment of £3. 3. Secretary of the B. C. A., Mr. Hoffer.

One of twenty-one games played simultaneously at Worthington, Jan. 24, 1885:—

Evans Declined.

White. Mr. Gunsberg.	Black. Mr. J. B. Mason.
1. P to K4	P to K4
2. Kt to KB3	Kt to QB3
3. B to B4	B to B4
4. P to QKt4	B to Kt3
5. P to Kt5	QKt to K2 (*a*)
6. Kt × P (*b*)	P to Q4 (*c*)
7. P × P (*d*)	Kt × P (*e*)
8. Castles (*f*)	KKt to B3
9. P to Q4	P to KR3 (*g*)
10. B to Kt2 (*h*)	Castles
11. B × Kt	Kt × B
12. P to QB4	Kt to KB5
13. P to B5	Q to Kt4 (*i*)
14. Q to B3	B to KR6

Black.

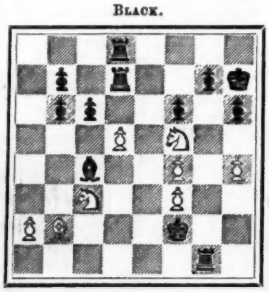


White.

15. P to Kt3 (*j*)	B × R
16. Q × Kt (*k*)	Q × Q
17. P × Q	QB × KtP
18. P × B	RP × P

White. Mr. Gunsberg.	Black. Mr. J. B. Mason.
19. Kt to QB3	B to R3
20. P to KB3 (*l*)	P to KB3
21. Kt to Kt6	KR to K sq.
22. K to B2	B to Q6
23. Kt to KR4	QR to Q sq.
24. P to Q5	R to Q2
25. R to Q sq.	B to B5
26. Kt to KB5	KR to Q sq.
27. R to Kt sq. (*m*)	K to R2
28. P to KR4	P to QB3 (*n*)

Black.



White.

29. P to KR5	P × P
30. Kt to K2 (*o*)	B × P
31. Kt (K2) to Q4	R to K sq.
32. R to QB sq.	B to B5
33. R to K sq.	R × R
34. K × R	P to QKt4
35. Kt to K6	R to KB2
36. Kt to Q6	R to K2

Drawn (*p*).

NOTES.

(*a*) Kt to R4 is the proper move.

(*b*) White may also play B to Kt2 or P to B3, which he could follow up by P to Q4 and Q to Kt3; in any case he would have a good game. The Black QKt on K2 is more in the way than useful.

(*c*) Correctly played.

(*d*) If B × P, Kt × B. 8. P × Kt, B to Q5. 9. Q to K2, Q to K2, would not be favourable for White.

(*e*) If B to Q5 instead of Kt × P, then White would play 8. Kt × P, K × Kt. 9. P to QB3, threatening to get his piece back next move by P to Q6 (ch), with an open game and a P more.

(*f*) 8. Kt × P instead of Castling would lead to complications without any particular advantage for White. Black's best reply to this would probably be B × P (ch). 9. K to B sq., &c.

(*g*) Black should have Castled.

(*h*) Very often, especially in close games, or where the B has free range, B to Kt2 is a serviceable move, but general principles require the QB on the K's side. It would have been much better to play B to R3. Black soon takes advantage of the unfavourable position of the White QB by playing Q to Kt4, Kt to B5, &c.

(*i*) Black institutes a spirited but premature attack.

(*j*) White would have kept the formation of his Pawns more intact, and would have had a better game by playing B to B sq.

(*k*) 16. K × B would have saved a P.

(*l*) 20. Kt to Q5 would have been better, as it threatens to win a P at once. Black from this point conducts his game with good judgment and considerable power.

(*m*) Useless, Kt to K3 was imperative. The QP is thereby weakened unnecessarily.

(*n*) Well designed. Of course, White cannot play P × P, on account of R to Q7 (ch), but if Black would have played B × P instead of P to B3 the game would have continued as follows:—

28.	B × P
29. Kt × B	R × Kt
30. R × P (ch)	K to R sq.
31. B × P	R × Kt
32. B to R sq.	R (B4) to Q4
33. R × P (ch)	K to Kt sq.
34. R to Kt7 (ch)	K to B sq.
35. R × P	R (Q sq.) to Q3

36. B to B3 with no disadvantage.

(*o*) White deals very recklessly with his Pawns.

(*p*) Black in the end game tried hard to play for a win, and although the position is slightly in his favour, we think nothing but a draw should result. If, for instance, 37. P to B5, B to Q6. 38. Kt to QB8, &c.

We have received a handsomely-printed and well-got-up volume published by Robert Clarke & Co., Cincinatti, U.S.A., containing a reprint of Cook's Synopsis, third edition, and also an American supplement of 126 pages, the whole edited by J. W. Miller. It is a sad yet true fact, that through various reasons we have no reliable book in England wherein the Openings are dealt with in the spirit of modern discovery. Cook's Synopsis itself is out of print, and the promised fourth edition is conspicuous by its absence. Poor Marriott is dead, and with him the hope of seeing an immediate issue of a modern work. Under these circumstances Messrs. Clarke's work, although constituting in this country an infringement of copyright, is nevertheless the only Chess book we know of from which an advanced learner would derive much benefit.

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